Final Report

Geothermal Research - Monitoring and Testing Project

Monitoring and Testing (M&T) Subproject

by

Harry J Olson
Principal Investigator
Hawaii Natural Energy Institute
School of Ocean and Earth Science and Technology
University of Hawaii at Manoa

30 September 1994

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CONTENTS

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SUMMARY:

The Department of Business, Economic Development and Tourism/School of Ocean and Earth Science Technology (DBED&T/SOEST) Geothermal Research - Monitoring and Testing Project contract summarizes the tasks of the Monitoring and Testing (M&T) Subproject as follows:

1) continue maintenance and instrumentation of the existing Scientific Observation Holes (SOH) holes to monitor fluid pressure, and
2) contract for continued analysis of deep well testing data that has already been acquired.

The SOHs and the HGP-A well have been continuously monitored, with the exception of minor downtime caused by infrequent instrument problems, on approximately monthly intervals since March, 1992. Results of the data have been supplied to DBED&T, SOEST, Hawaii Natural Energy Institute (HNEI), Puna Geothermal Venture (PGV) and GeothermEx, Inc. Monitoring began in March 1992, approximately 13 months prior to commencement of production at PGV on April 20th, 1993. There were no signs of interference at any of the stations during the period monitored. Analysis of the pressure data strongly suggests that through going fractures or zones of permeability are not present along the Kilauea East Rift Zone (KERZ) between PGV and SOH-4 to the west and SOH-2 to the east, or across the KERZ between PGV and SOH-1 to the north and the HGP-A well to the south. The pressure data confirms the conclusion that the PGV and HGP-A reservoirs are small and discontinuous, as concluded in the SOH Program Final Summary Report.

The M&T project also funded the purchase and installation of a downhole seismometer into the HGP-A well, and successfully managed the installation operation within schedule and without incident.

Copies of the computer disks with the digital data and the analog graphs from the M&T project are included at the end of the report as Appendix I and II. Instructions and procedures for the Pruett Datalogger are included in Appendix III, and the installation schedule for the downhole seismometer is given in Appendix IV.

M&T PROJECT ACTIVITIES:

The three SOHs, together with the HGP-well, are ideally positioned along the KERZ to provide an overall analysis of the geothermal resource, and to provide data on the subsurface temperature, structure, and hydrology of the KERZ. SOH-1 was located to test for cross rift permeability to the north of the PGV production, and HGP-A to test for permeability to the south. SOH-2 was located approximately 2.5 miles to the east of the PGV wells as a stepout to test conditions along the rift to the east, and SOH-4 was located to test conditions about 5 miles west along the rift. SOH-3, which was not drilled, was located to test cross rift permeability to the north of the T/MPGV well. The larger number of commercial wells that are concentrated within the PGV property provide a detailed picture of the producing area which confirms the conclusions of the SOH and M&T projects. Figure 1 gives the location of the SOHs and the HGP-A well, as well as other geothermal wells and the Geothermal Resource Subzones in the Puna area along the KERZ.

After the drilling phase of the SOH program was completed, continuous monitoring of the SOHs and the HGP-A well commenced as soon as the pressure monitoring instruments could be installed. Pressure monitoring was designed to record

LOCATION OF SOHs ON THE BIG ISLAND

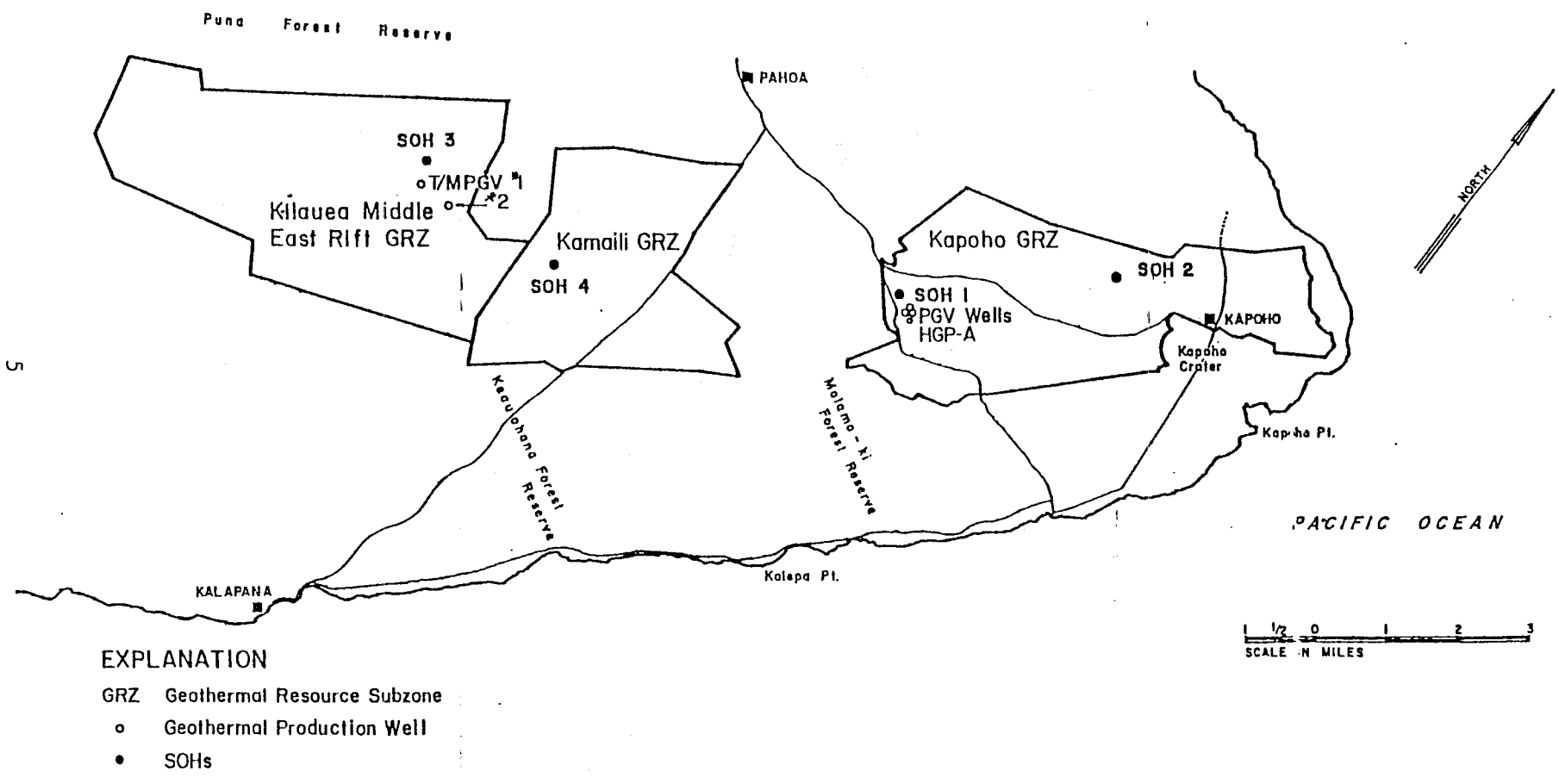


Figure 1

any possible communication between producing wells at the PGV development in a form that would permit reservoir analysis, and to record long term changes in the hydrology of the KERZ that could be related either to geothermal development or natural causes. This monitoring will develop essential baseline data regarding the KERZ and will allow the State to manage and regulate the geothermal resource on the basis of fact rather than upon conjecture and speculation.

Pressure data for the M&T project are collected by the Pruett Mini Max/Blue Max Datalogger capillary tube monitoring system that is installed in the SOHs and the HGP-A well. The capillary tubing is filled with helium gas under pressure that requires "purging" on an infrequent basis to prevent well fluids from entering the tubing. Another Pruett Datalogger system capable of monitoring both temperature and pressure was acquired by the M&T project for installation in HGP-A, or another well of opportunity, but was not installed. These instruments require only minor maintenance which usually can be accomplished in the field. Repairs that require shop maintenance can be quickly completed by shipping the instruments to:

Pruett Industries International
8915 Rosedale Highway
Bakersfield, California 93308
Phone: 805-589-2768
Fax: 805-589-3268

This monitoring system has the capability to measure and record pressure build-ups and draw-downs, injection and fracture information, and flowing step rate and interference data, at temperatures in excess of 700° Fahrenheit. The system has all the advantages and benefits of data recorded and stored at the surface in real time at selectable intervals with no electronics in the hole and calibration at the surface.

The data are downloaded from the Dataloggers monthly and stored on computer disks. Computer graphs of the data are inspected on a monthly basis to note any variations that can be attributed to pressure interference between the SOHs and the HGP-

A well and PGV's producing wells. Throughout most of the M&T project, pressure measurements from the SOHs and the HGP-A well were recorded at hourly intervals in a digital format that can be displayed and printed. These data are automatically converted to a graphical format by the instrument and printed in the field as soon as the data from the wellhead instrument are downloaded into the computer. A copy of the downloading instructions and procedures are given in Appendix III.

To provide a period of baseline data collection prior to the commencement of PGV's production, the instruments and monitoring systems were installed in March 1992, and data collected prior to the initial testing and production at PGV's KS-9 well on April 20, 1993. Baseline pressure data was collected on 60 minute intervals, with the exception of several short periods prior to, during, and following the start of the well test or production at PGV, when data was collected at shorter intervals of 5, 15, and 30 minutes. Afterwards, monitoring intervals were increased to 60 minutes after sufficient data were collected to indicate that the longer interval would provide all the essential data without missing any significant events. During baseline and subsequent data collection, only diurnal atmospheric and tidal pressure fluctuations were recorded with no significant increases or decreases which could indicate a pressure breakthrough from PGV's production wells to the SOHs or the HGP-A well, or fracture related changes in the groundwater hydrological system. Longer term pressure fluctuations probably are related to seasonal or meteorological conditions.

During the testing and start-up of production at PGV's wells, no indications of interference between the production wells, and the monitoring stations at SOH-1 and the HGP-A well were noted. Also, during shut-downs and start-ups of the production wells, pressure build-ups or draw-downs were not noted. The up and down "spikes in the pressure data given in Appendix II are believed to represent instrument "noise" rather than actual groundwater conditions. Due to the complex interactions between reservoir temperature, pressure, rate of production, and fluctuating liquid/steam fractions, reliable

estimates of ultimate reservoir producibility and longivity probably will not be available for several years.

During the monitoring and testing period all the SOHs had no wellhead pressure. HGP-A, however, existed under pressure during the entire period of pressure monitoring. As illustrated on the pressure graphs in Appendix II, sharp increases with a rapid falloff of pressure are the result of periodic pressure releases at the well.

During the first half of January, 1994, prior to the Puna earthquake on the night of January 31st, SOH-4 experienced normal diurnal tidal pressure fluctuations. However, amplitude of the pressure fluctuations for the last half of the month were greatly reduced. Pressure measurements in some wells in other tectonically active areas on the Mainland are reported to have registered wide pressure fluctuations prior to large magnitude earthquakes. Perhaps long term monitoring along the KERZ will reveal a relationship between subsurface pressure fluctuations and impending earthquakes.

The M&T project provided funds for the purchase of the downhole seismometer for the geophysics subproject and the installation of the seismometer into the HGP-A well. The M&T project also contributed to some of the design activities related to installation concerns.

After several delays relating to the delivery and testing of the seismometer, installation was scheduled for the four day period, July 18th through 21st. Installation followed the planned schedule with minor changes to accommodate operational problems, and the installation was completed on schedule without incident or the necessity of killing the well. Although the seismometer was deployed successfully, subsequent instrument failure required the removal of the seismometer and the shut-in of the HGP-A well. The seismometer installation schedule is given in Appendix IV.

The Department of Land and Natural Resources (DLNR) took over management of the M&T project at the termination of the contract period. Prior to the transfer of project management, DLNR personnel were briefed as to the status of the project and in operation of the instruments in the field.

PERSONNEL:

To obtain the benefits of data collected by the SOH program, DBED&T entered into a contract with the University of Hawaii/SOEST to conduct the Geothermal Research - Monitoring and Testing project of which M&T is a subproject managed by HNEI. SOEST subsequently contracted with the Research Corporation of the University of Hawaii (RCUH) to manage the disbursement of project funds.

H. J. Olson (HNEI) was principal investigator and was responsible for overall management of the M&T project. P.C. Thompson (RCUH) served as project specialist responsible for office administration and pressure data collection in the field. Thompson transferred to DBED&T's Energy Division's Geothermal Project Office on June 1st, 1994, but continued to assist the M&T project on an "as needed" basis. S. R. Evans (RCUH) served as research assistant responsible for the SOH office and equipment at the Puna Research Center (PRC) on the Big Island and pressure data collection in the field until her termination on February 28th, 1993.

CONSULTANTS:

GeothermEx, Inc., a geothermal consulting group with offices in Richmond, California, who were currently under contract with DBED&T and who had experience working on the SOH program and the HGP-A well, were contracted to supervise the installation of the downhole seismometer into the HGP-A well. E. Granados, a senior

drilling engineer with GeothermEx coordinated the installation of the seismometer in the field. M. Gardner, and other personnel with GeothermEx assisted with coordination between the service companies involved with installation of the seismometer.

E. Pruett and D. Pruett, of Pruett Industries International, a well logging and service company with offices in Bakersfield, California supervised the extraction of the Pruett Datalogger System from the HGP-A well and assisted with the installation of the seismometer.

FUNDING:

Funds in the amount of $1,500,000 for the Geothermal Research - Monitoring and Testing project were supplied by the State and managed by DBED&T. The M&T project initially was funded in the amount of $219,483 for a two year period. This amount was subsequently reduced in several increments to $144,100 due to programmatic changes and DBED&T's budgetary requirements. Expenditures for the project, by accounting category, are shown by the Budget Status Report in Figure 2.

CONCLUSIONS:

o The M&T project advanced the geothermal assessment and characterization of the KERZ which began in the early 1970s. It is important for geothermal development in the KERZ that the monitoring program be continued, and expanded to other holes of opportunity, to provide an unbroken pressure record. In addition to a better understanding of the resource potential of the KERZ, the data collected during the M&T project will prove to be vital to the regulatory function of the various State agencies and will augment the State's resource management program. The data will be especially

RESEARCH CORPORATION OF THE UNIVERSITY OF HAWAII

PROJECT NUMBER: 8678 - GEOTHERMAL A98E88 OLSON
PRINCIPAL INVESTIGATOR: RALEIGH, G.B.
80EST

TO: H. OLSON .50
HNEI

COMMENCEMENT DATE: 07/92
EXPIRATION DATE: 06/95

TP		BUDGET CATEGORY	AMOUNT AWARDED	CURRENT EXPENDITURES	TOTAL EXPENDITURES	OUTSTANDING PURCHASE ORDERS	TOTAL COSTS	AVAILABLE BALANCE
A	01	SALARIES	73,300.00	.00	82,913.12	.00	82,913.12	9,613.12-
B	02	FRINGE BENEFITS	18,700.00	.00	21,836.15	.00	21,836.15	3,136.15-
C	03	EQUIPMENT	2,200.00	.00	1,072.00	.00	1,072.00	1,128.00
D	04	SUPPLIES	1,900.00	.00	1,346.19	.00	1,346.19	553.81
E	05	TRAVEL	10,900.00	.00	6,969.38	.00	6,969.38	3,930.62
F	06	CONSULTANTS	23,900.00	.00	6,816.43	.00	6,816.43	17,083.57
G	07	PUBLICATIONS	300.00	.00	425.00	.00	425.00	125.00-
S	08	OTHER	14,700.00	1,800.00	24,147.08	.00	24,147.08	9,447.08-
		TOTAL DIRECT COSTS	145,900.00 *	1,800.00 *	145,525.35 *	.00 *	145,525.35 *	374.65 *
		GRAND TOTAL	145,900.00 **	1,800.00 **	145,525.35 **	.00 **	145,525.35 **	374.65 **

COPY TO: DEAN NAKANO
335 MERCHANT ST., RM 110
HON, HI. 96813

NOTE:
WHEN APPLICABLE, PAYROLL INFORMATION FOR THE LAST PAY PERIOD OF THE MONTH WILL APPEAR ON THE SUBSEQUENT MONTH'S REPORT. THIS IS DUE TO THE PAYROLL PROCESSING CYCLE AND APPLIES TO BOTH UH AND RCUH EMPLOYEES ASSIGNED TO THIS PROJECT.

WHEN APPLICABLE, DEPENDING ON THE SPONSORING AGENCY'S REQUIREMENTS, PROJECT PERSONNEL SHALL PROVIDE TO RCUH A REVISED BUDGET THAT HAS BEEN APPROVED BY THE SPONSORING AGENCY.

Figure 2

essential if the State's management and regulation of the resource is contested, because the party with the data usually prevails.

o No pressure interference was recorded between production at PGV and the SOHs or the HGP-A well.

o Due to the lack of interference between geothermal production at PGV and SOH-2 to the east and SOH-4 to the west, it is doubtful that throughgoing fractures or zones of permeability exist along the KERZ. Similarly, lack of interference between PGV and SOH-1 to the north and the HGP-A well to the south, suggest that cross rift permeability is not present also. The pressure data confirms the conclusion that the PGV and HGP-A reservoirs are small and discontinuous, as concluded in the SOH Program Final Summary Report.

RECOMMENDATIONS:

1. It is important that the M&T program be continued, and if possible expanded to maintain a complete record of groundwater pressure variations in the KERZ - especially in the vicinity of the PGV facility. Pressure, temperature, and groundwater chemical analysis are needed to the north and south of the KERZ to determine the effects of geothermal activity along the rift, and the effects, if any, of production at PGV. Pressure and temperature data from any holes of opportunity drilled in other rift zones would expand the State's knowledge of its geothermal resource base, and would be vital to the orderly development and management of geothermal energy in other areas of potential.

2. The Pruett temperature/pressure datalogger should be installed in a well of opportunity as soon as is feasible. The T/MPGV well, approximately 2 miles to the west of SOH-4, would be a prime candidate and besides extending pressure monitoring farther up-rift, could give early warning of magma intrusion into the KERZ. Barnwell's Lanipuna

#6 well, if available, would be another candidate to obtain temperature data adjacent to PGV's production in an area of suspected descending groundwater.

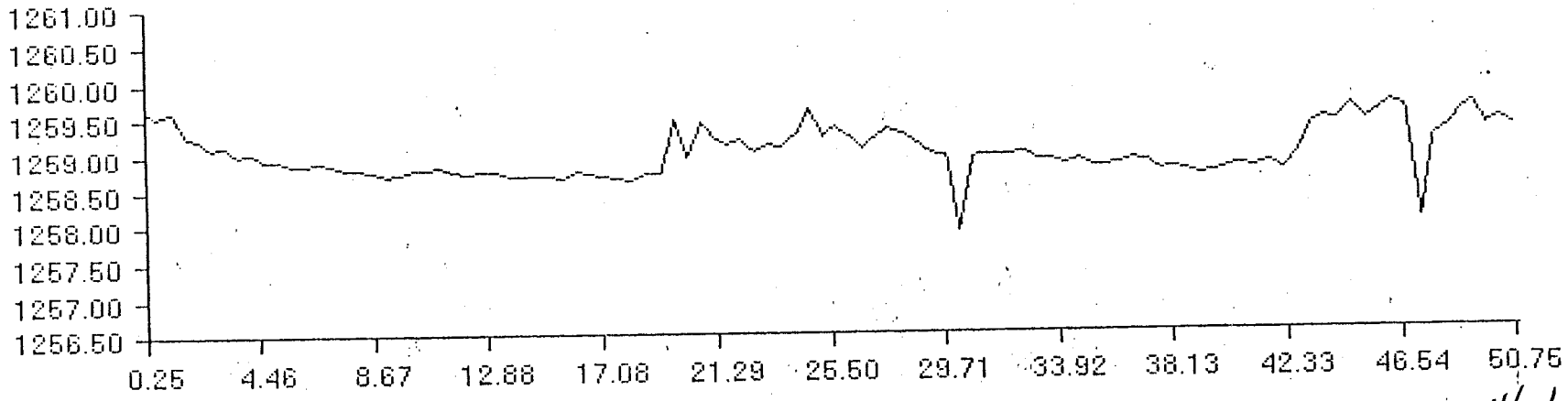
3. Continue to monitor groundwater pressure fluctuations and relate the resulting data, if possible, with ongoing nearby earthquake occurrences to determine if a correlation exists that could be useful in predicting earthquake occurrence.

APPENDIX I

Computer Disks with Digital Pressure Data

APPENDIX II

Graph of HGP-A Pressure Data



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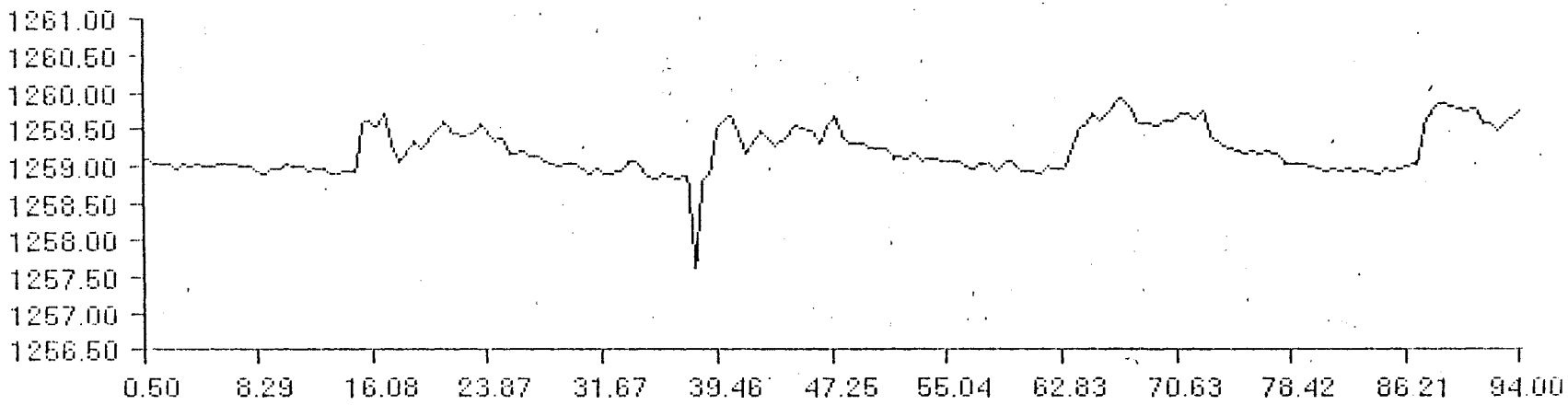
WHP = 73 psig



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4/7/92
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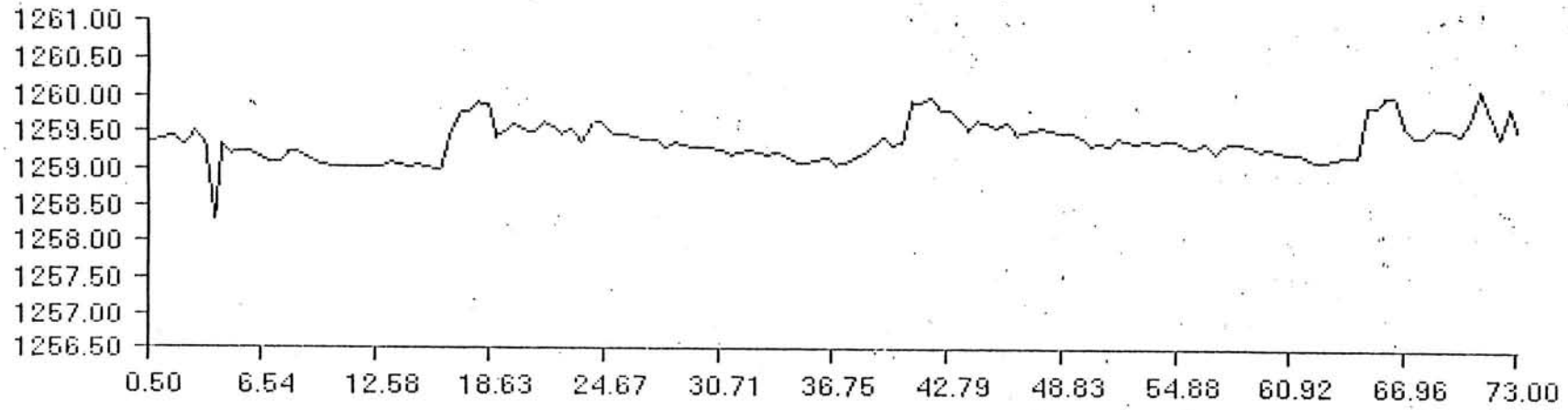
WHP = 79 psig



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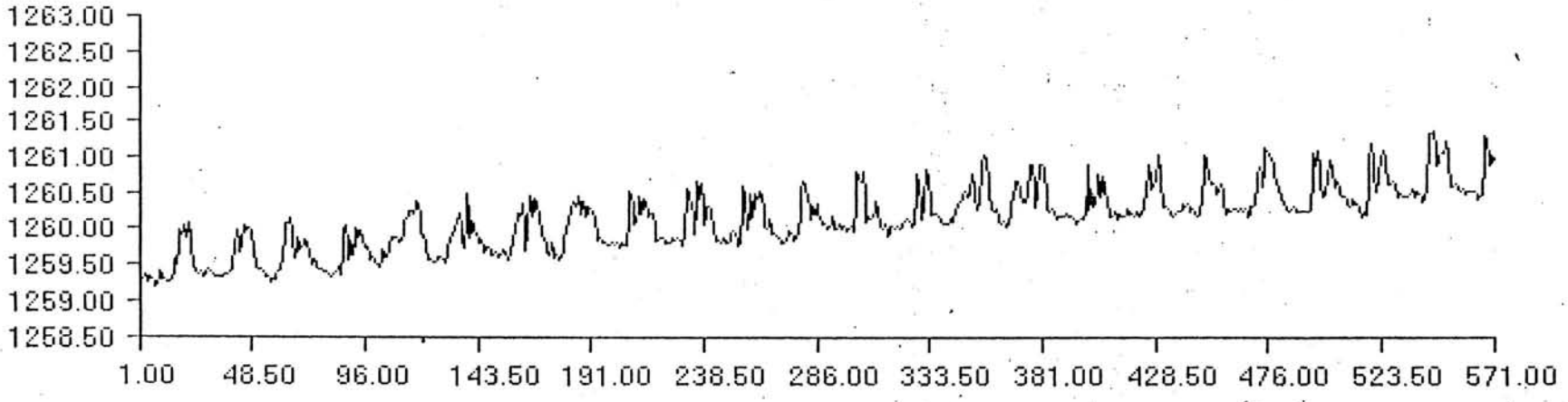

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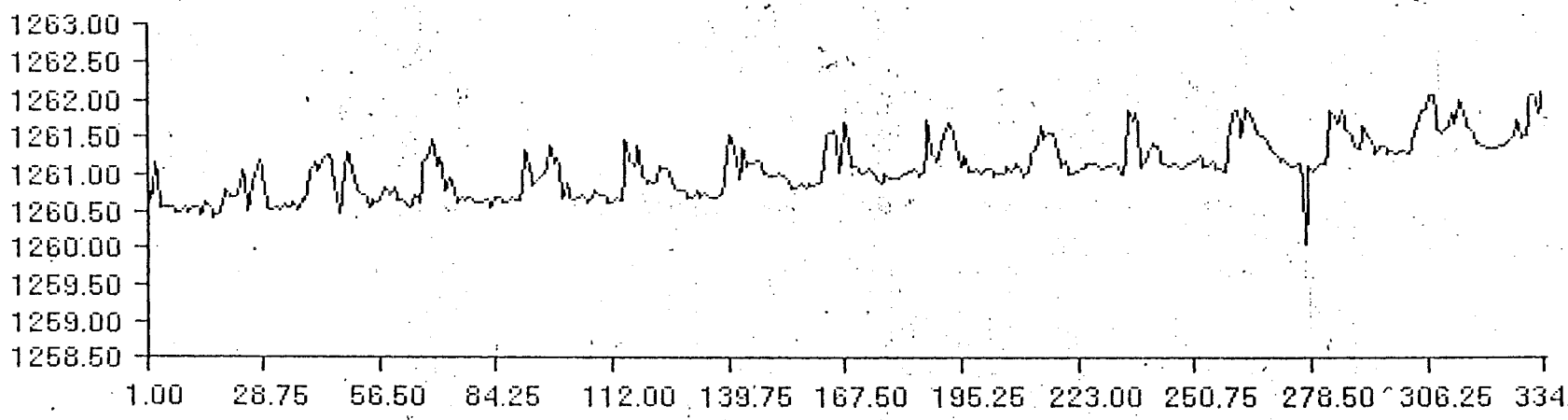

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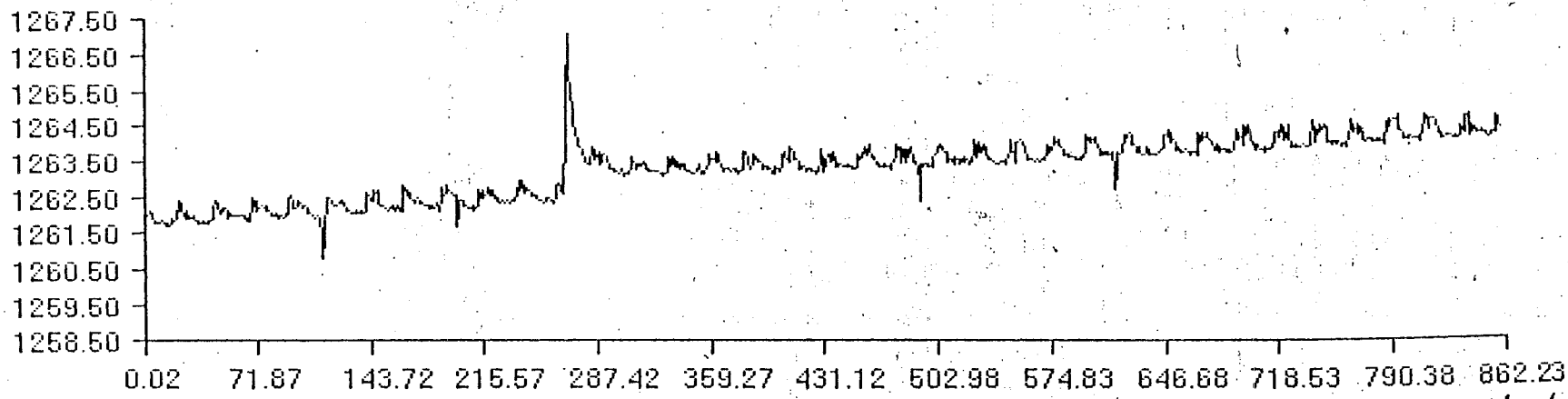

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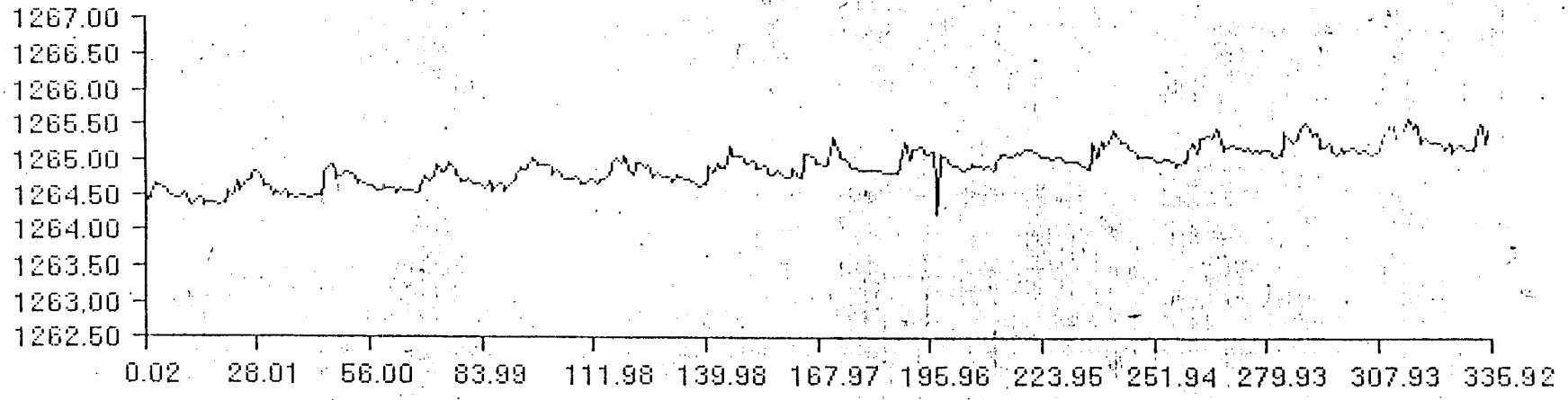
5/29/92 (268 HRS)
BLEED OFF WHP FROM 133 psig to ~60 psig



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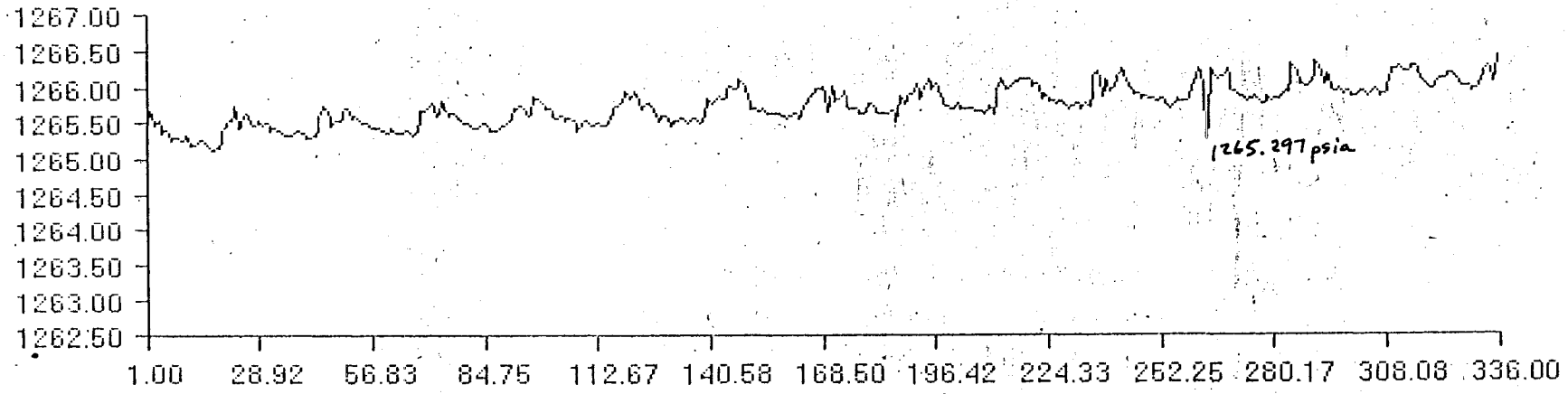

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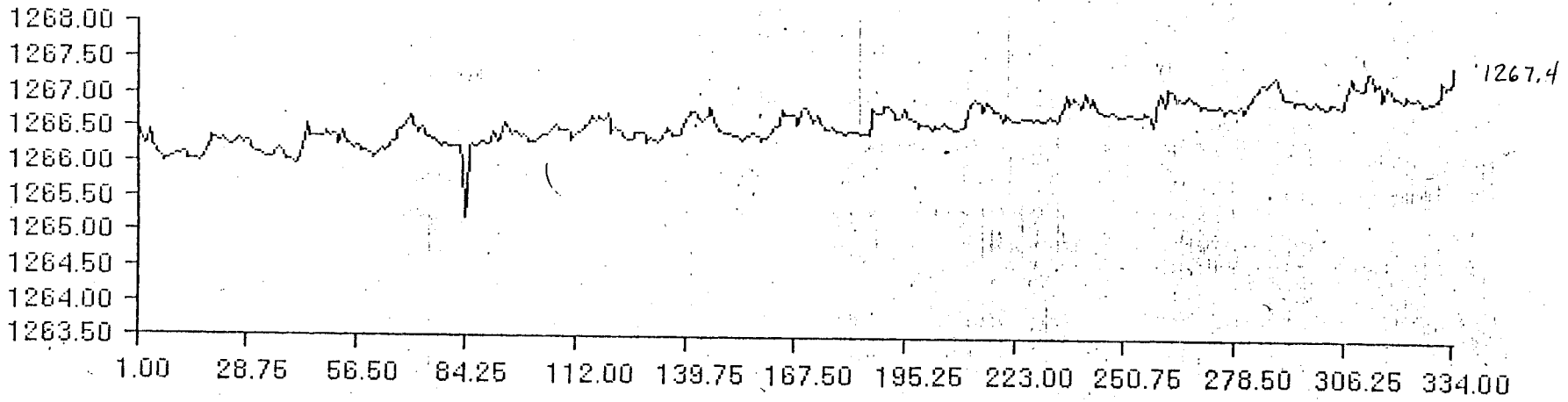

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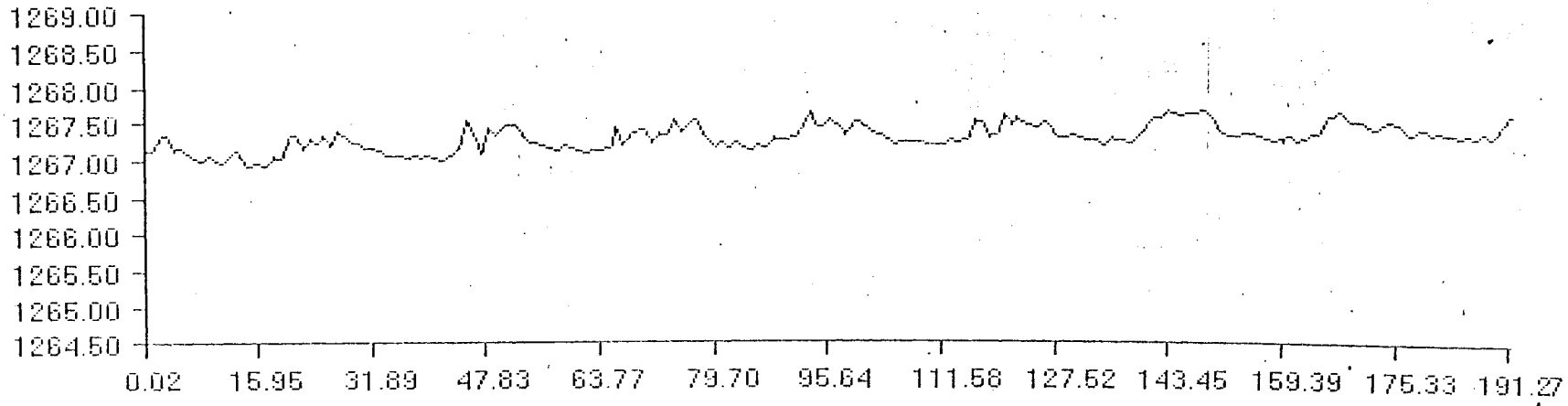

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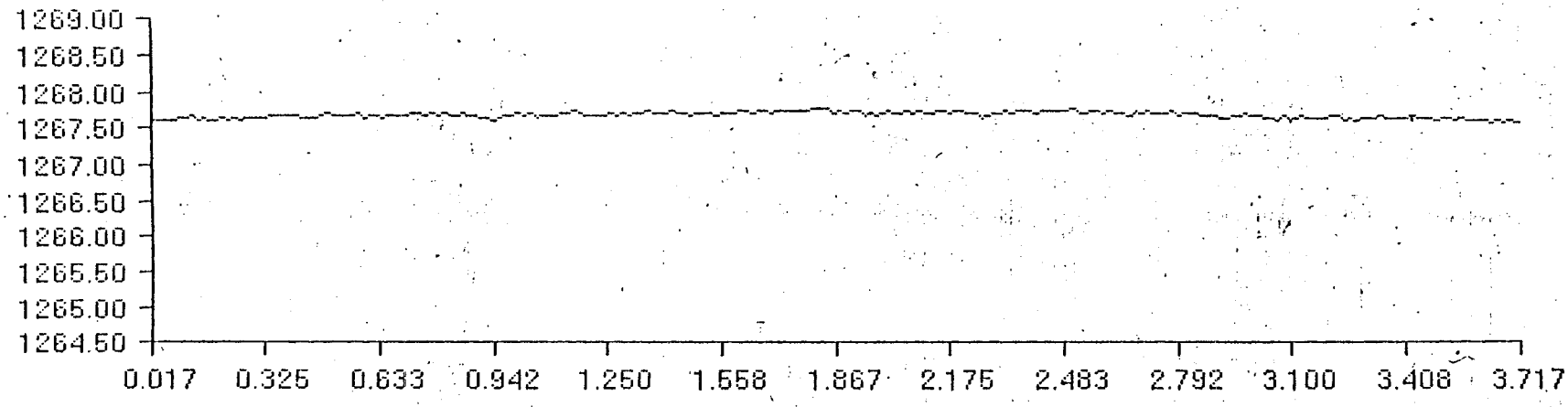

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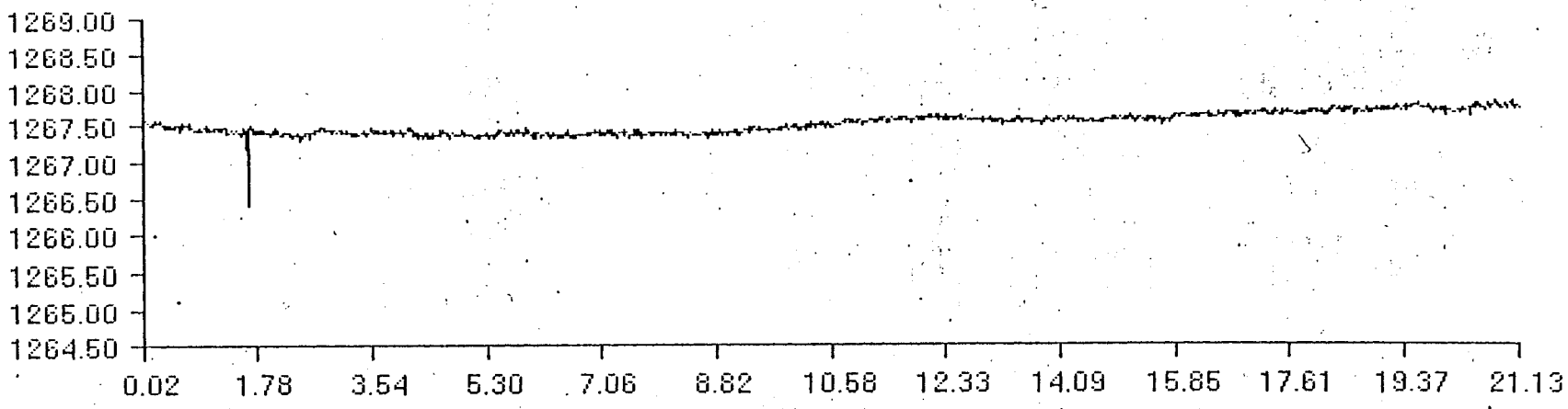

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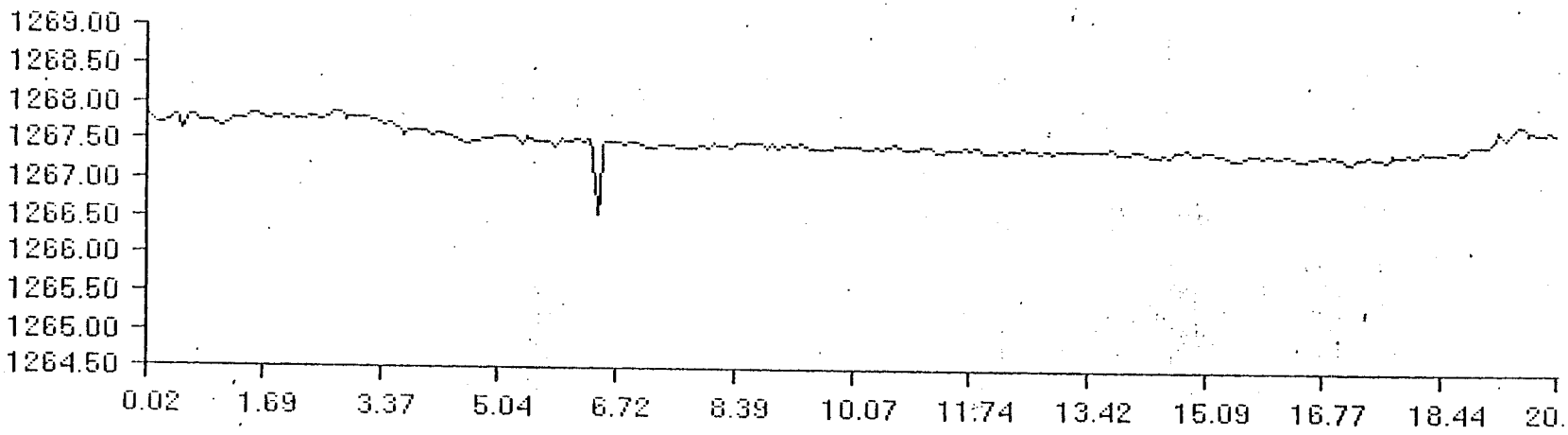
WHP = 111 psig



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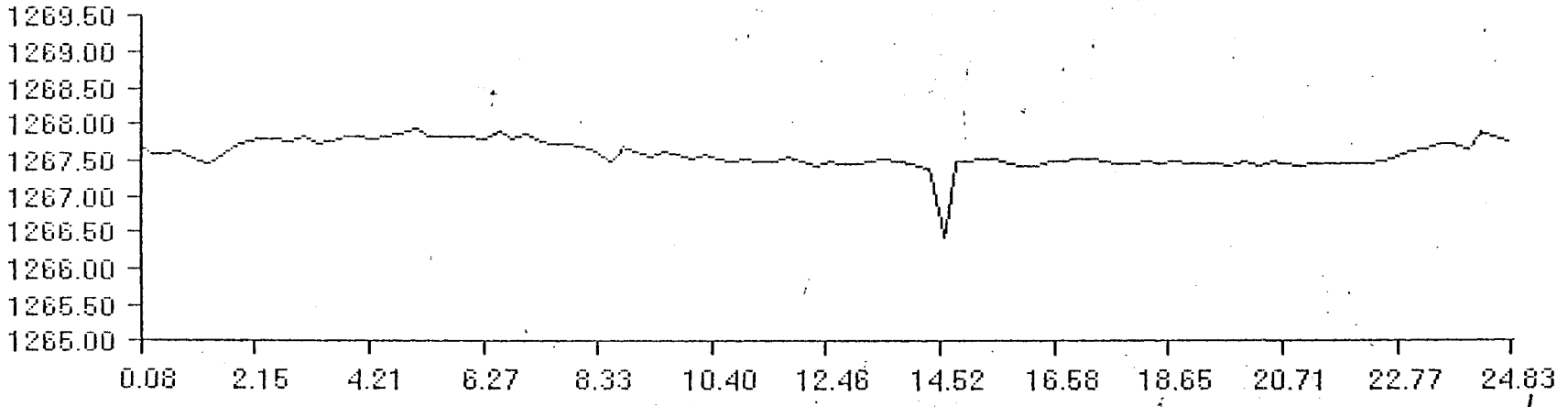

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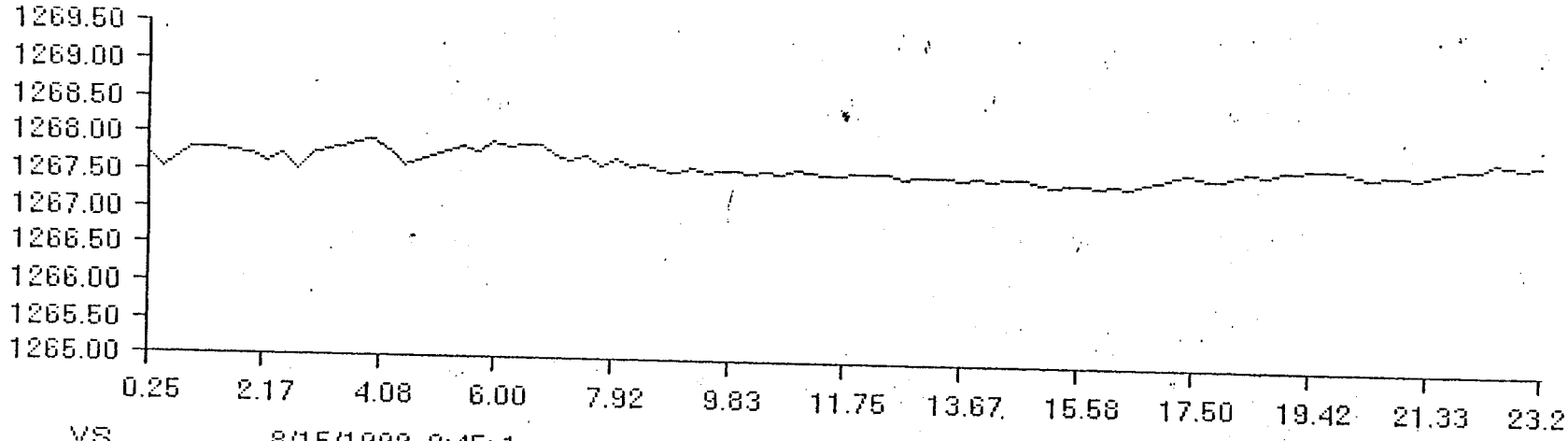

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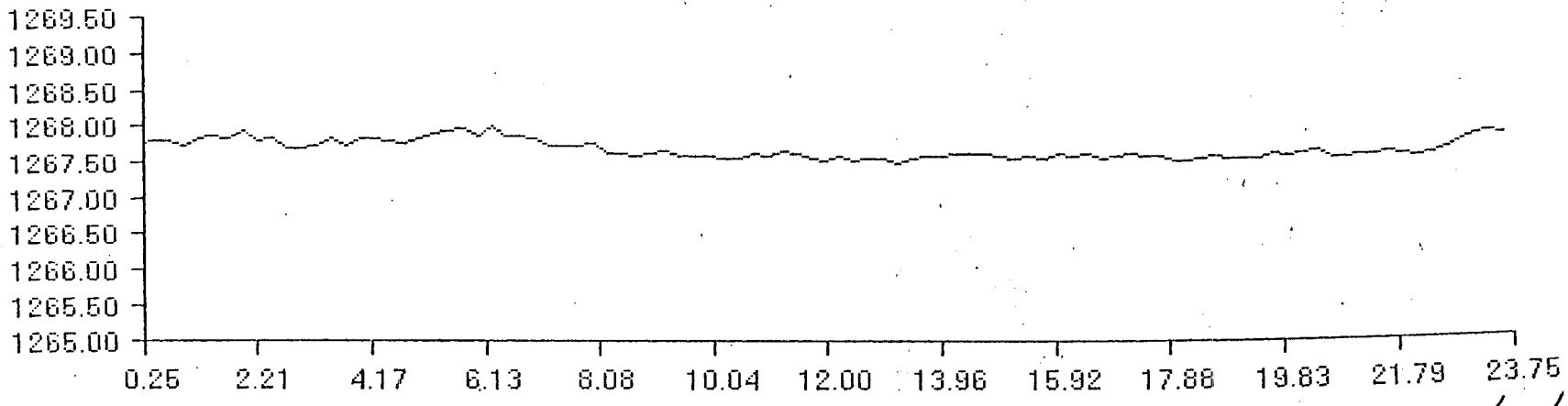
WHP = 113 psig



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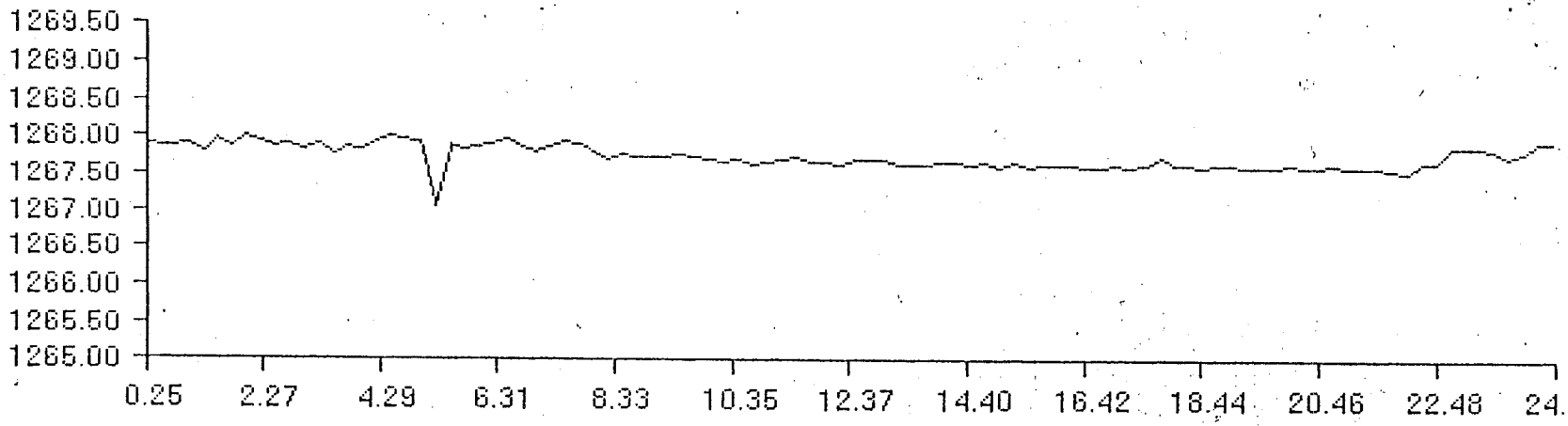
WHP = 113 psig



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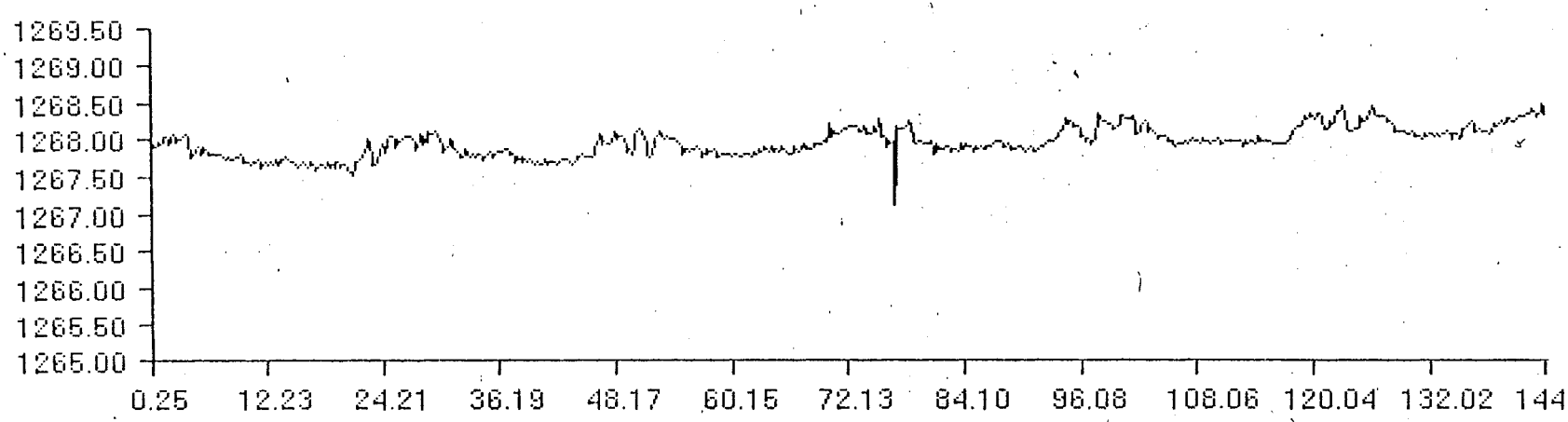

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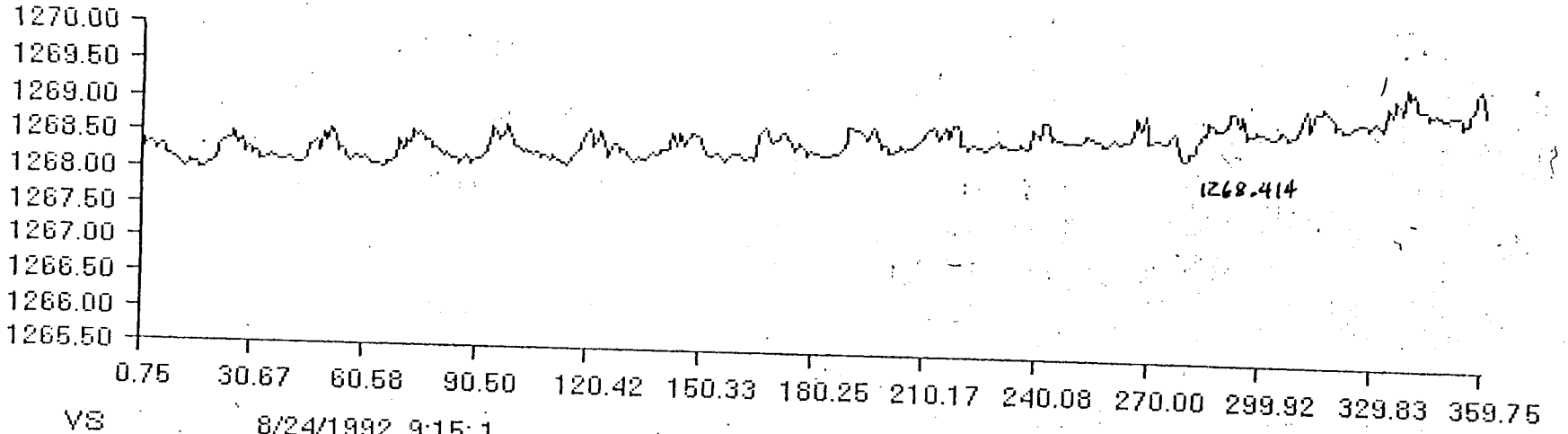

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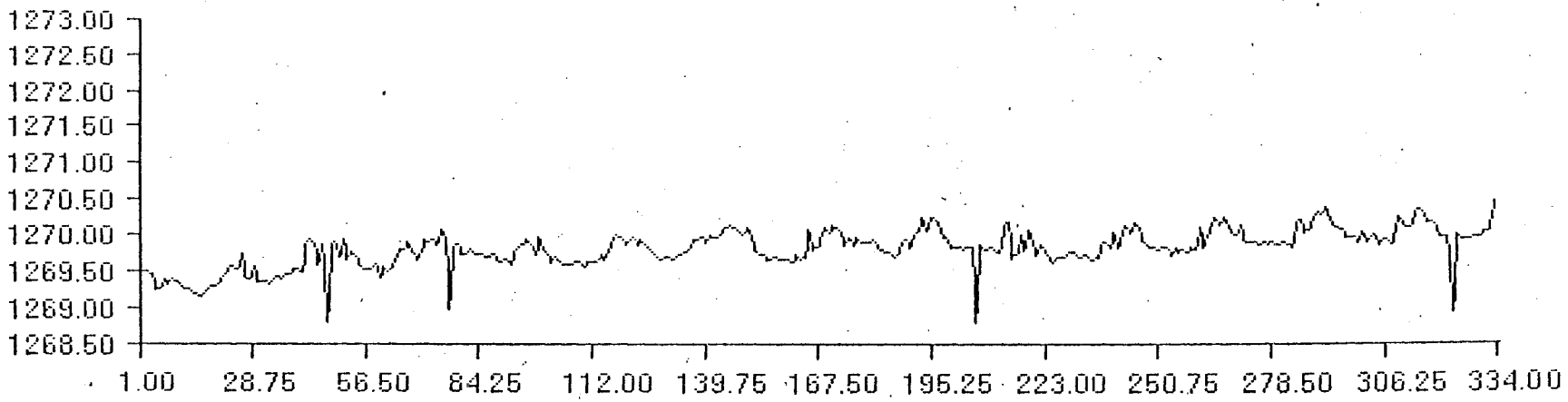

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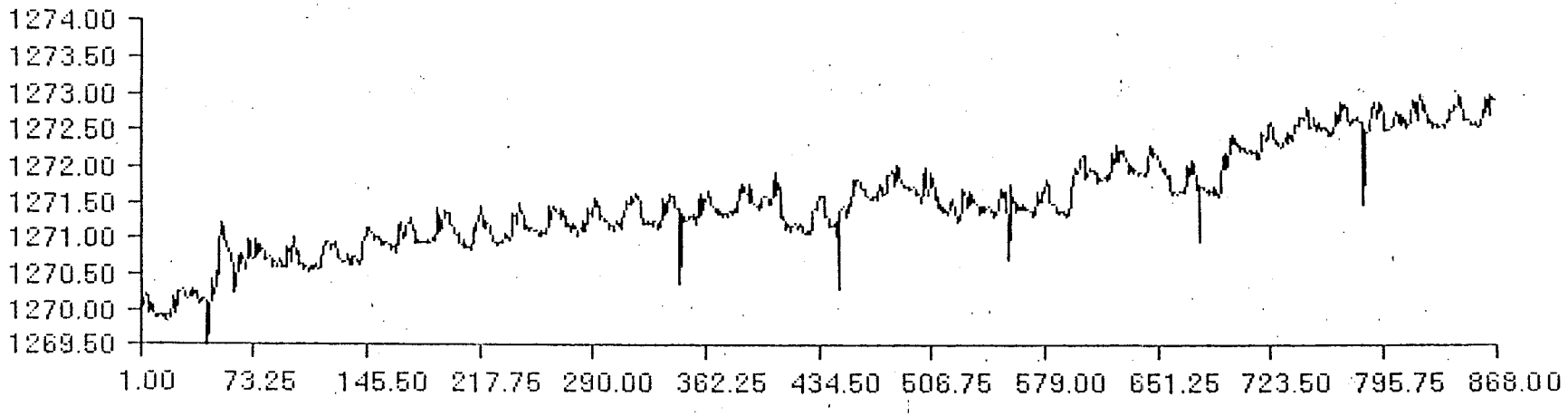
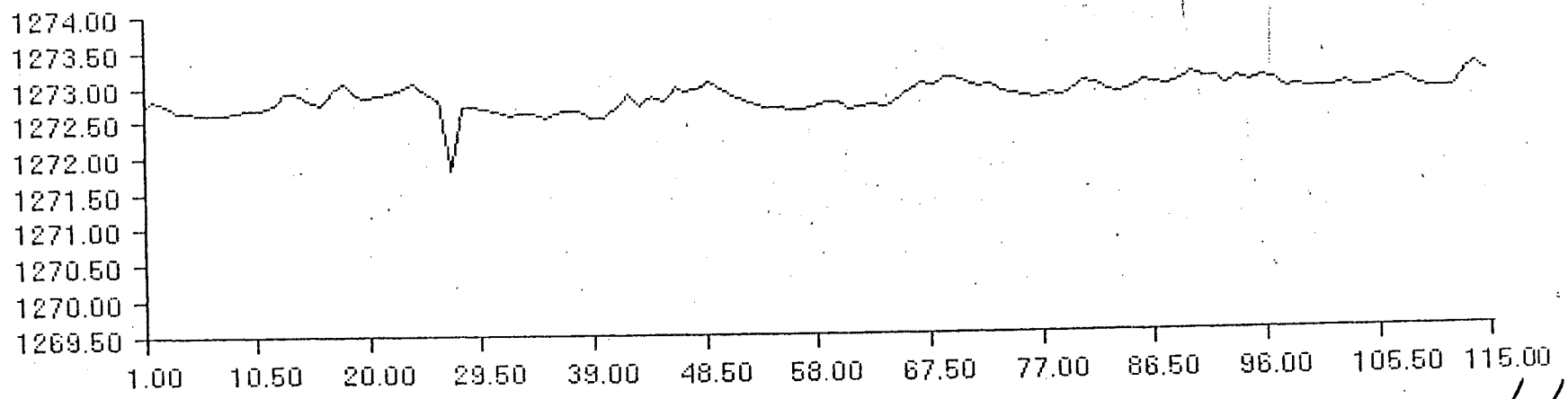


10/28/92
13:52

WHP = 126 psig

WHP = 136 psig

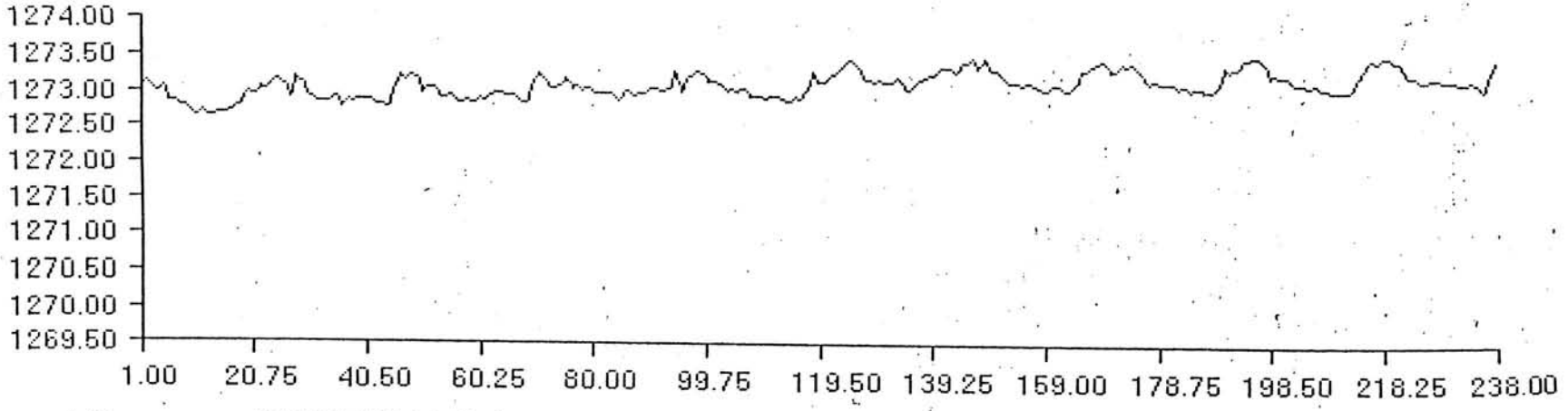


11/2/92
9:54

WHP = 136 psig

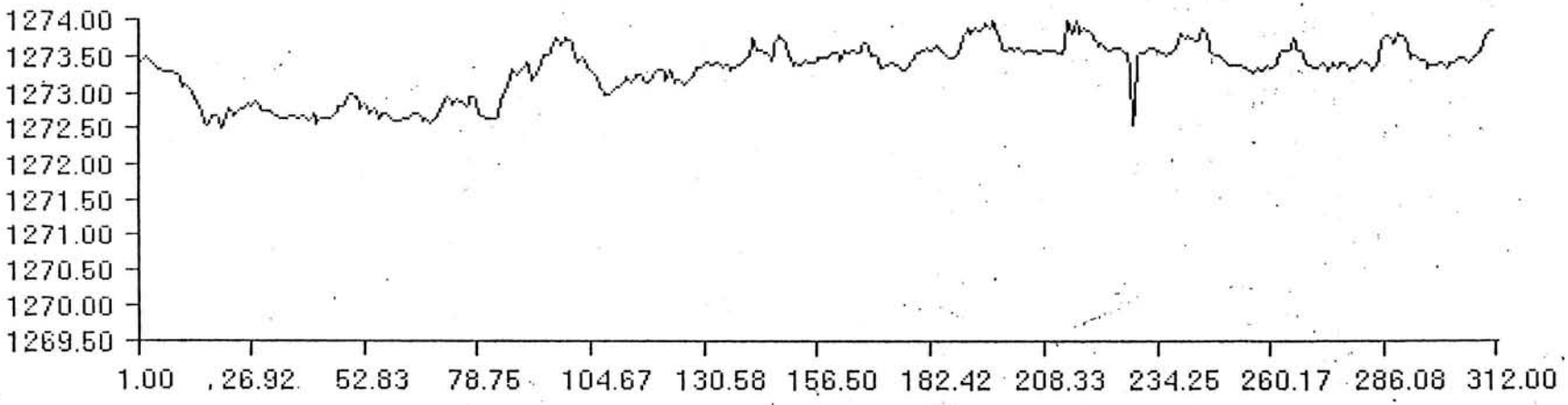
10/30/92

WHP = 139 psig



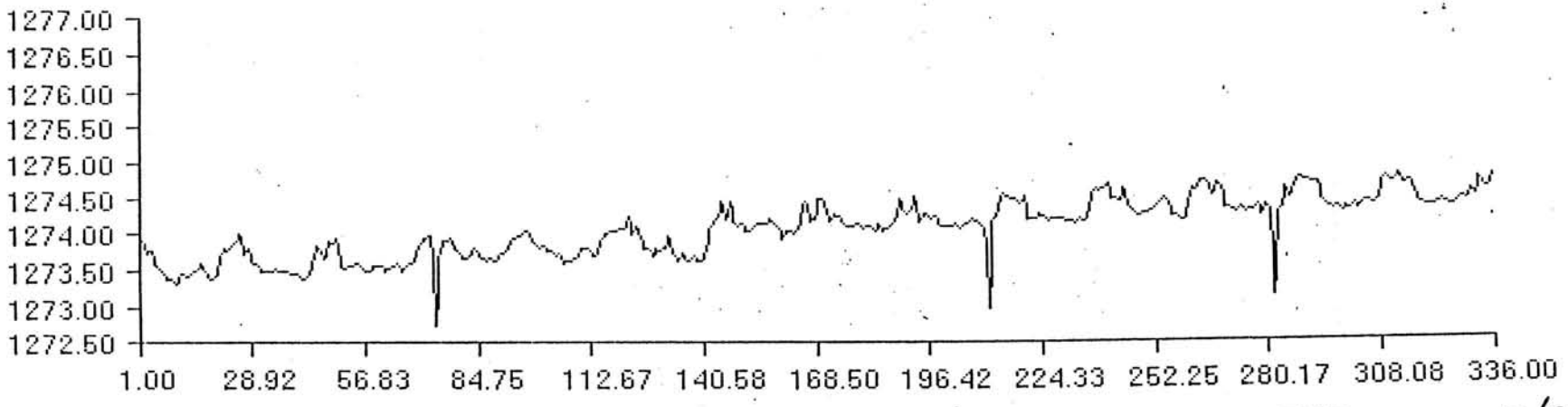
WHP=139 psig

11/12/92
8:54
WHP=143psig



WHP = 143 psig

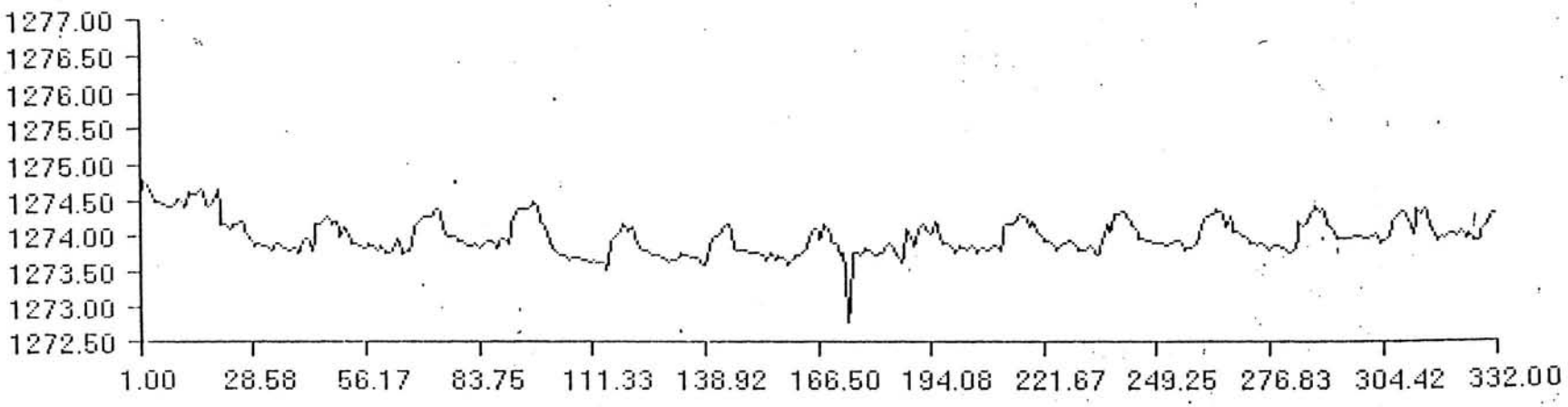
11/25/92
10:02
WHP=149psig



VS 11/25/1992 11: 0: 1 1OKAHGPA.SUR 12/9/92
<S=SCALE> <M=MARK POINTS> <P=PRINT> INTERVAL = 1 HR 11:01
14 DAYS

WHP=149 psig

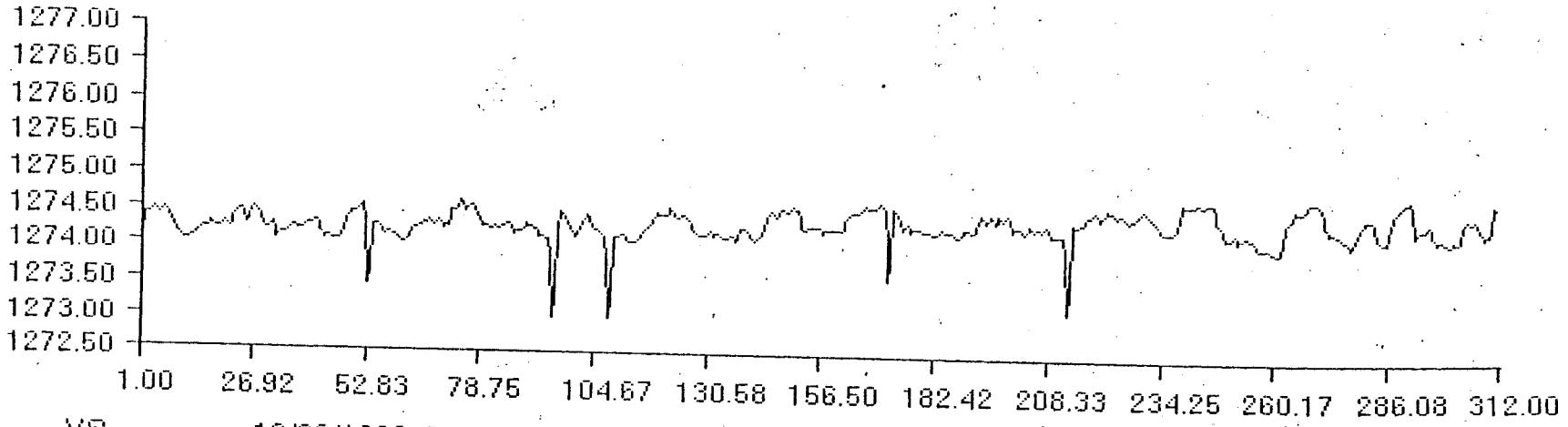
WHP= 155 psig



VS 12/ 9/1992 12: 0: 1 1PKAHGPA.SUR 12/23/92
<S=SCALE> <M=MARK POINTS> <P=PRINT> INTERVAL = 1 HR 8:20
14 DAYS

WHP = 160 psig

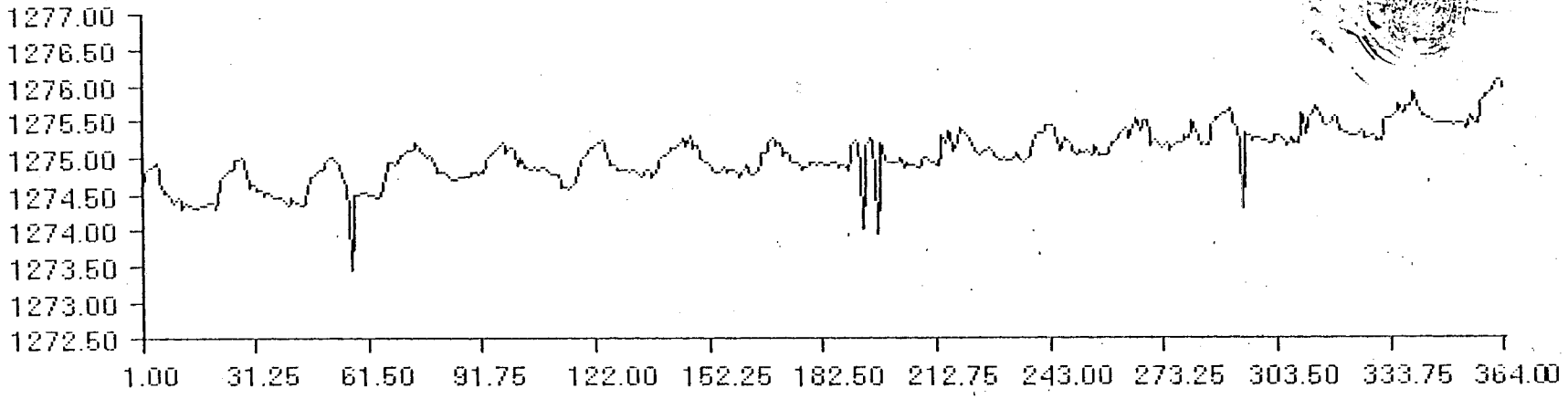
WHP = 155 psig



1/5/93
9:37

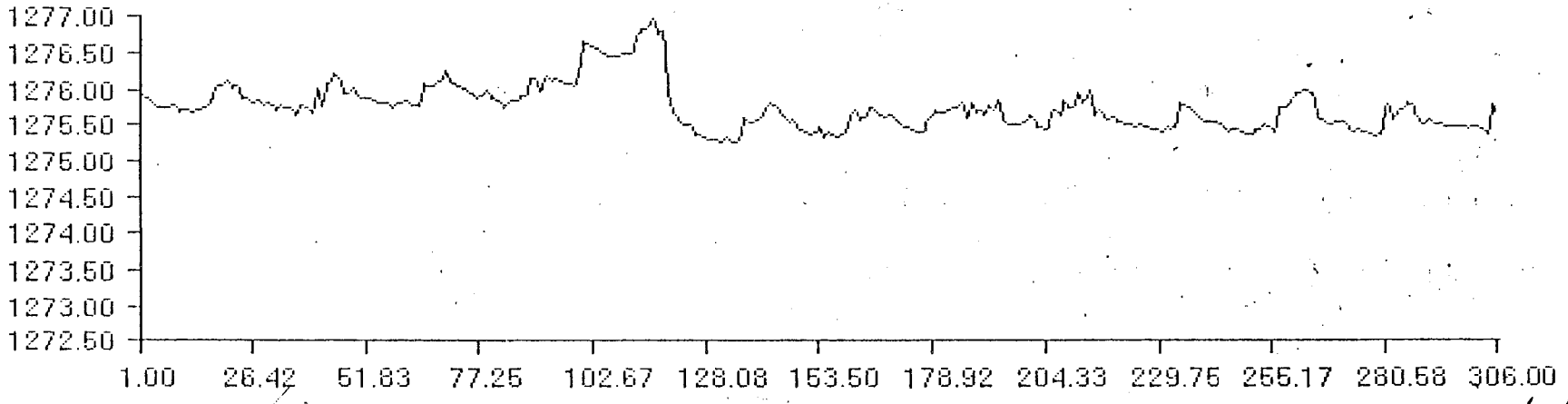
WHP = 160 psig

WHP = 167 psig



1/20/93
14:31

WHP = 176 psig



VS 1/20/1993 15: 0: 1 1SKAHGPA.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

INTERVAL = 1 HR

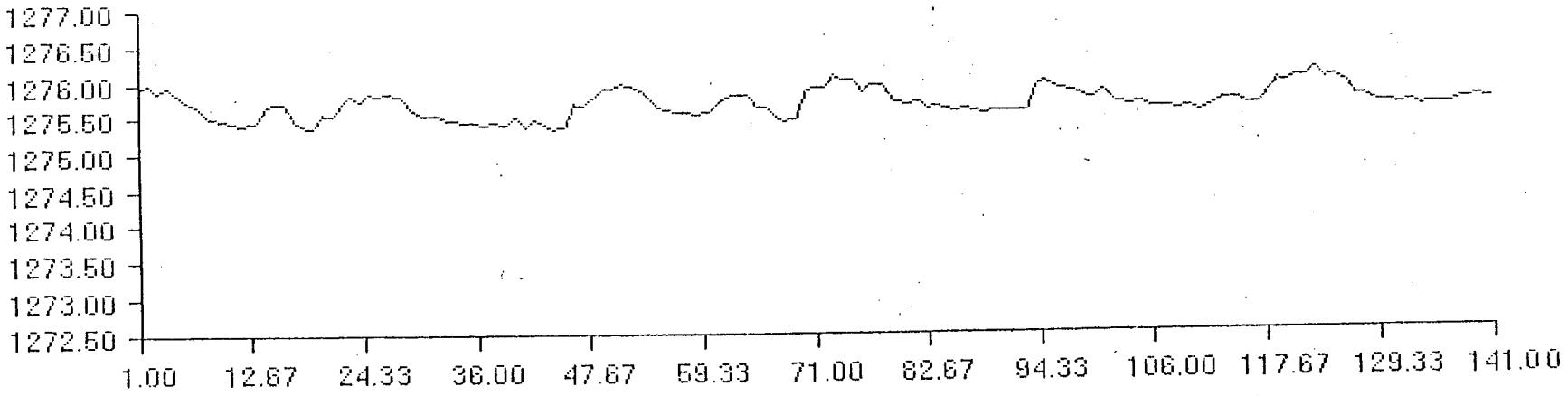
13 DAYS

2/2/93

9:21

WHP = 180 psig

WHP = 176 psig



VS 2/ 2/1993 10: 0: 1 1TKAHGPA.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

INTERVAL = 1 HR

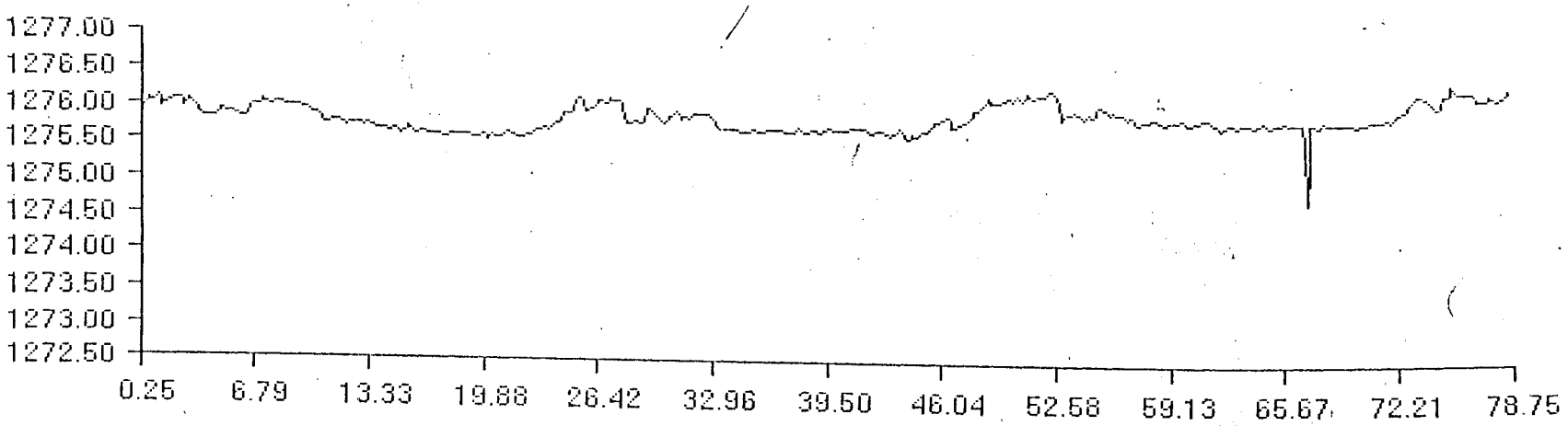
6 DAYS

2/8/93

718

WHP = 180 psig

WHP = 182 psig

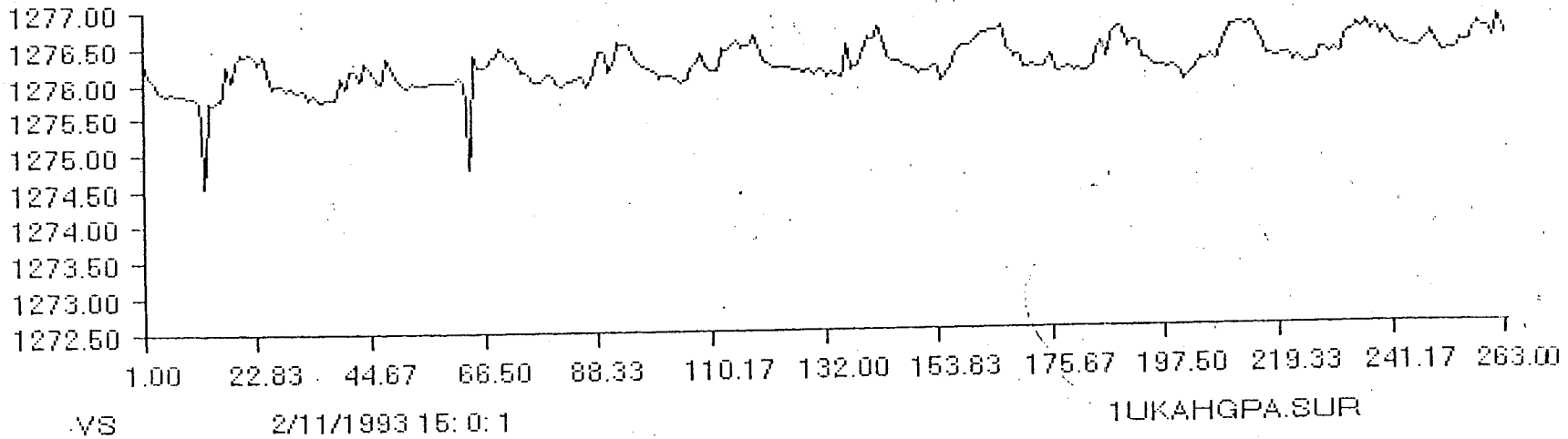


INTERVAL = 15 MIN
3 DAYS

2/11/93
14:16

WHP = 182 psig

WHP = 183 psig

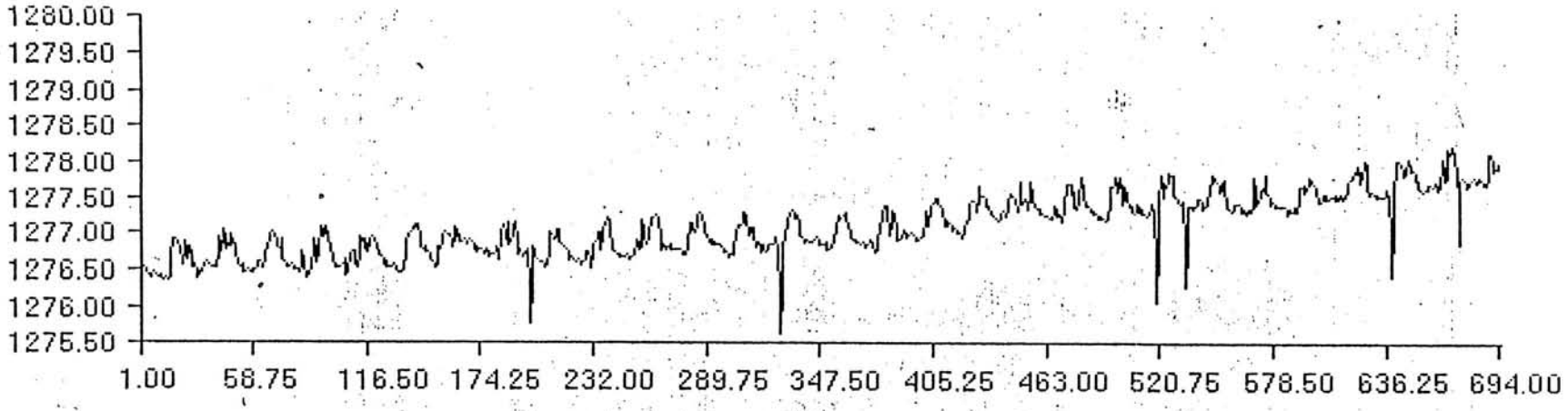


interval = 1 hour
11 days

2/22/93

WHP = 183 psig

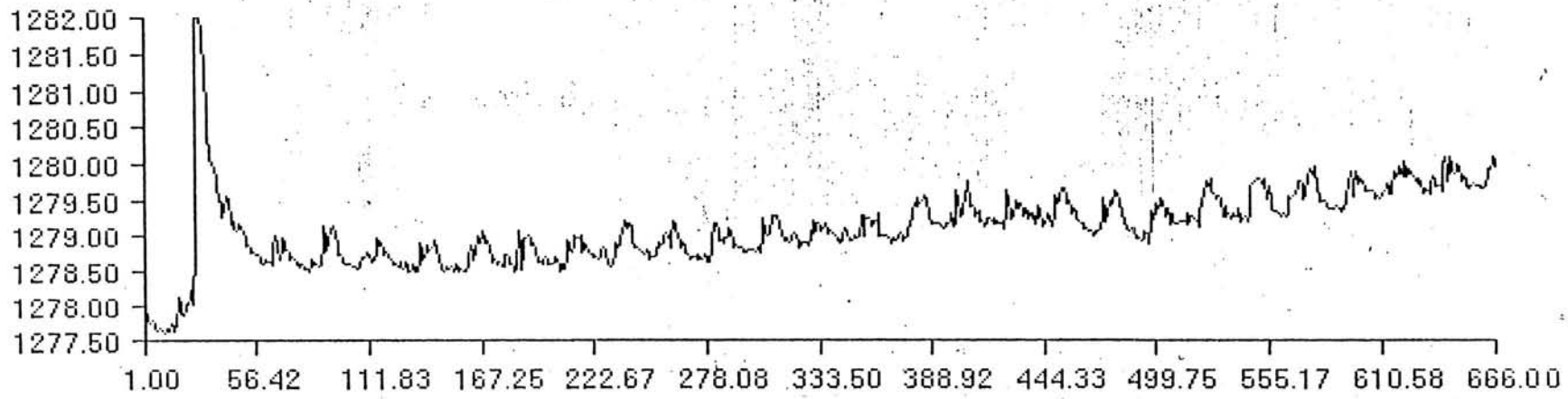
WHP = 184 psig



scale = prior to 3.00

interval = 1 hr
29 days

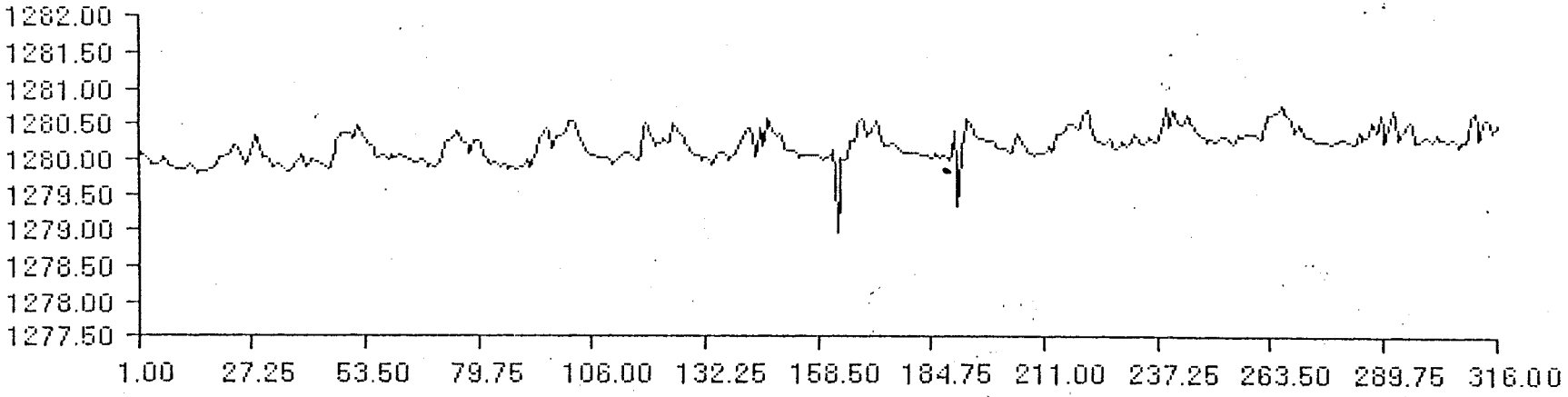
3/23/93
13:25



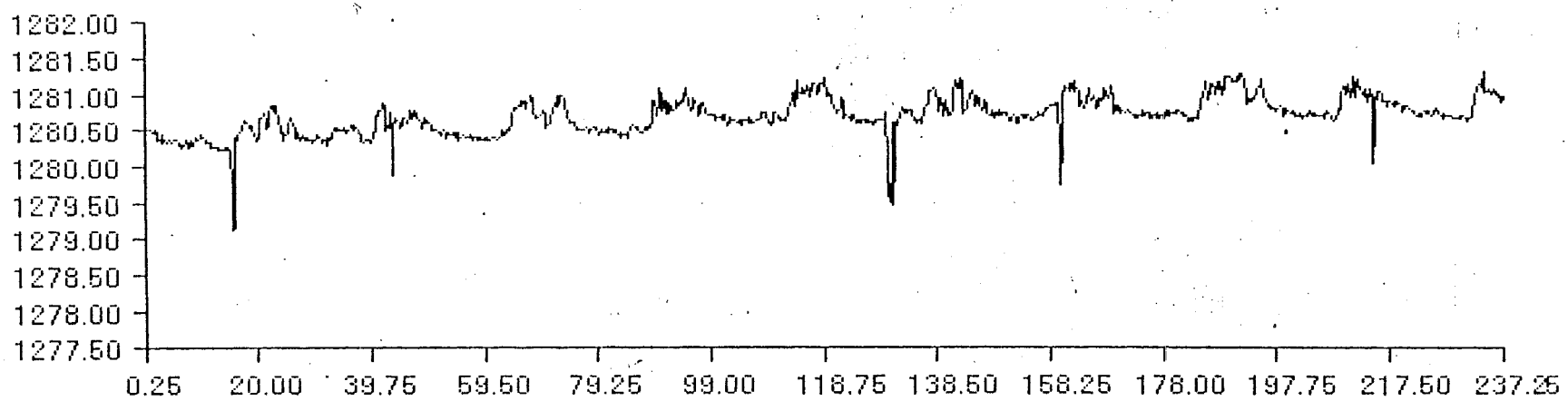
scale:
prior to

interval = 1 hr
28 days
4/20/93 8:20

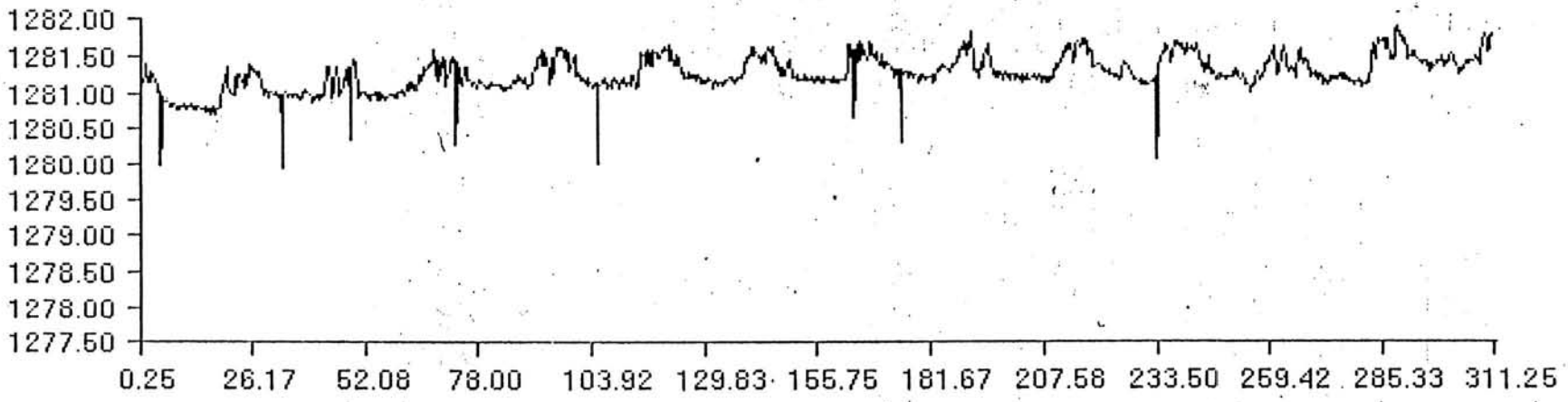
Pressure bled off 3/23/93 15:50 - 16:20.
Starting pressure 180 psig



interval = 1 hr
13 days
5/3/93 13:48
WHP = 107.75 psig



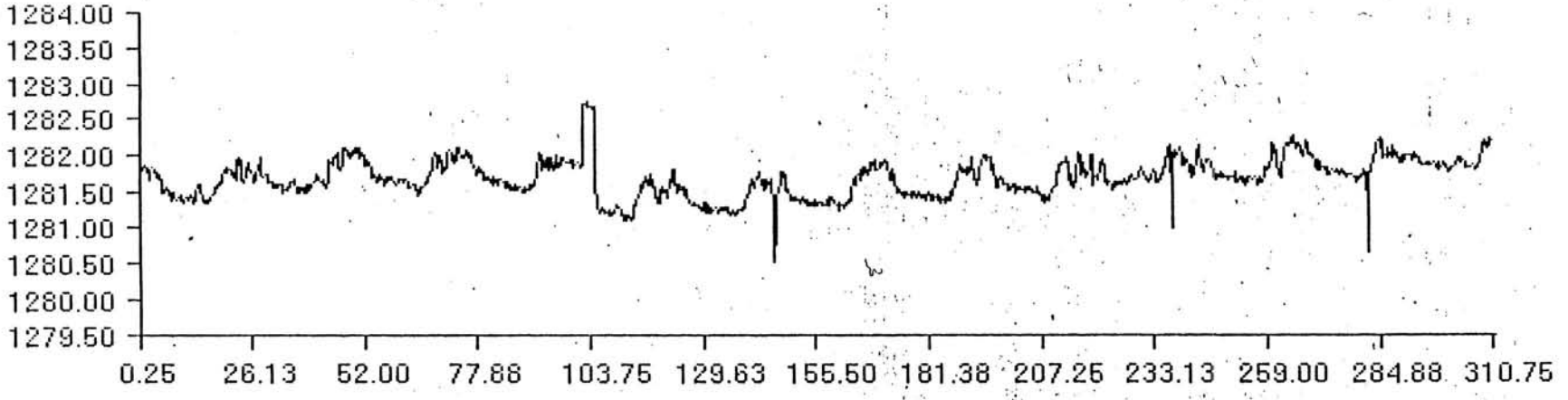
interval = 15 min
10 days
5/13/93 11:35



VS 5/13/1993 11:45: 1 1ZKAHGPA.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

interval = 15 min
13 days
5/26/93 11:10
WHP= 130 psig

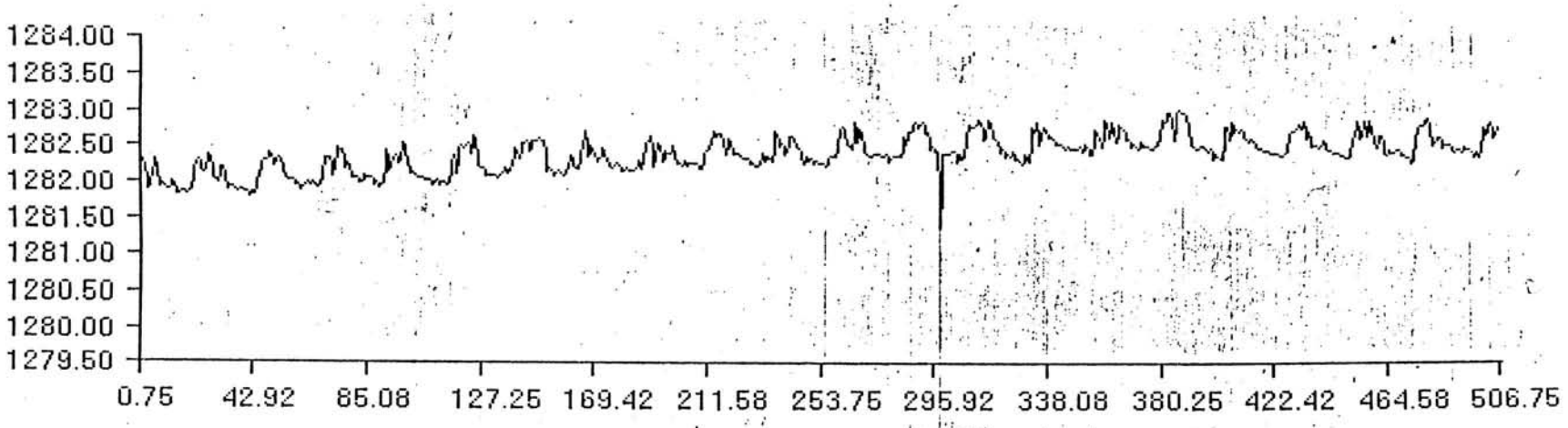


VS 5/26/1993 11:15: 1 1AKAHGPA.SUR

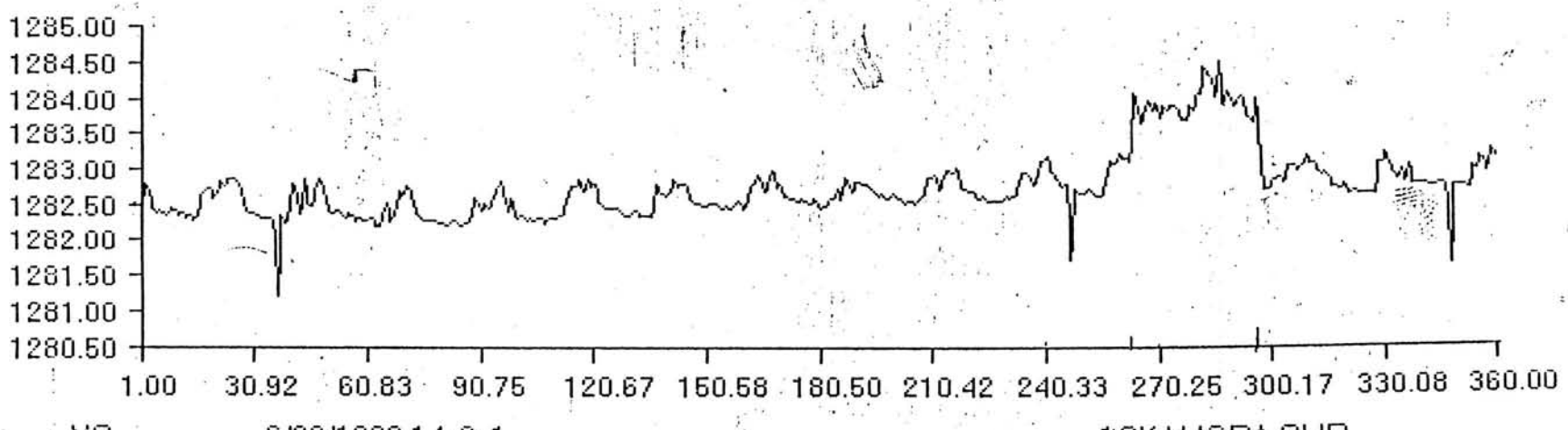
<S=SCALE> <M=MARK POINTS> <P=PRINT>

+2.00

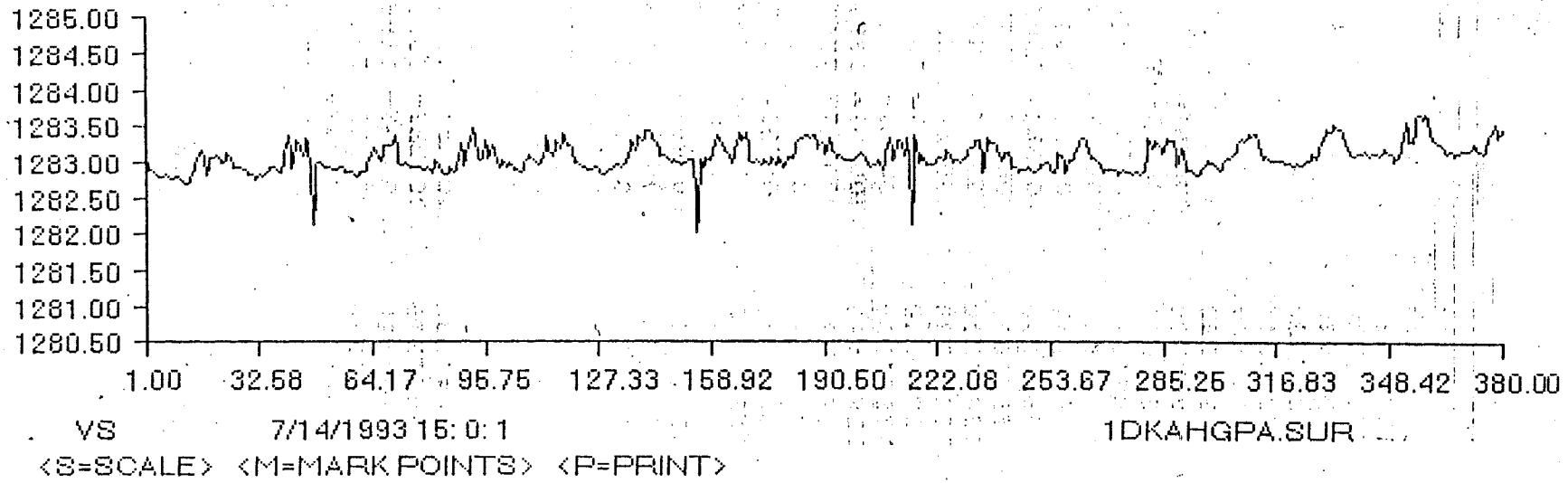
Interval= 15 min
13 days
6/8/93 10:15
WHP= 132.5 psig



Interval = 1 hr.
21 days
6/29/93 13:00
WHP= 151- psig

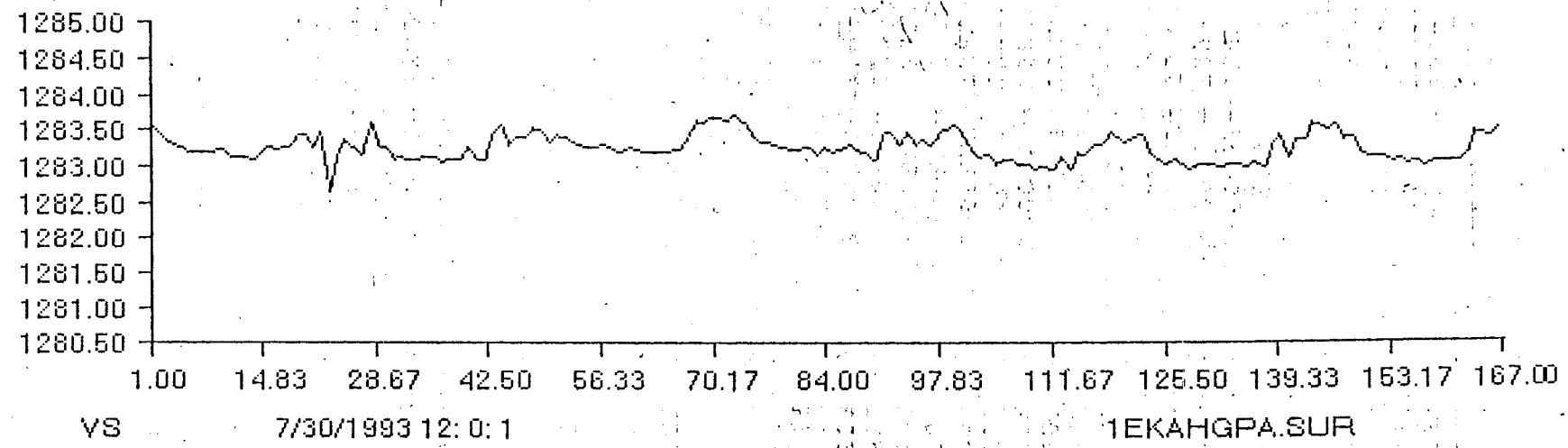


Interval = 1 hour
15 days
7/14/93 1447 hrs
WHP= 173 psig



3600SP1= 1284.006
3600SP1= 1284.018

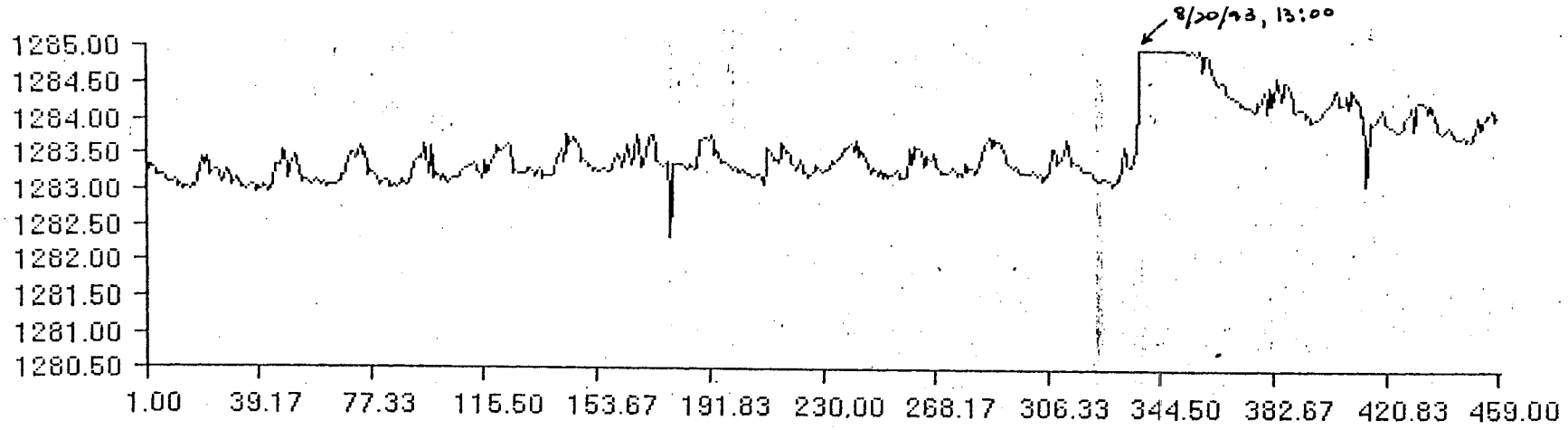
Interval = 1 hr.
16 days
7/30/93 11:00
WHP= 196+ psia



3600SP1= 1284.957
3600SP1= 1285.053

3600SP1= 1283.000
3600SP1= 1283.279

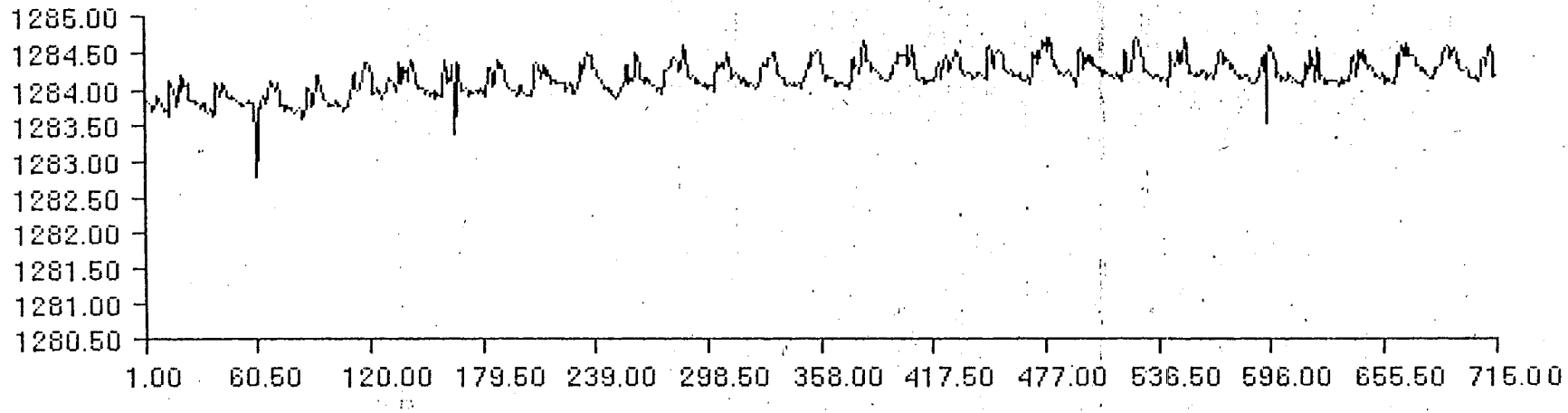
Interval = 1 hr.
7 days
8/6/93



Pressure bleed off 8/20/93, 12:30 - 13:15
start - 223 psi, End - 98 psi

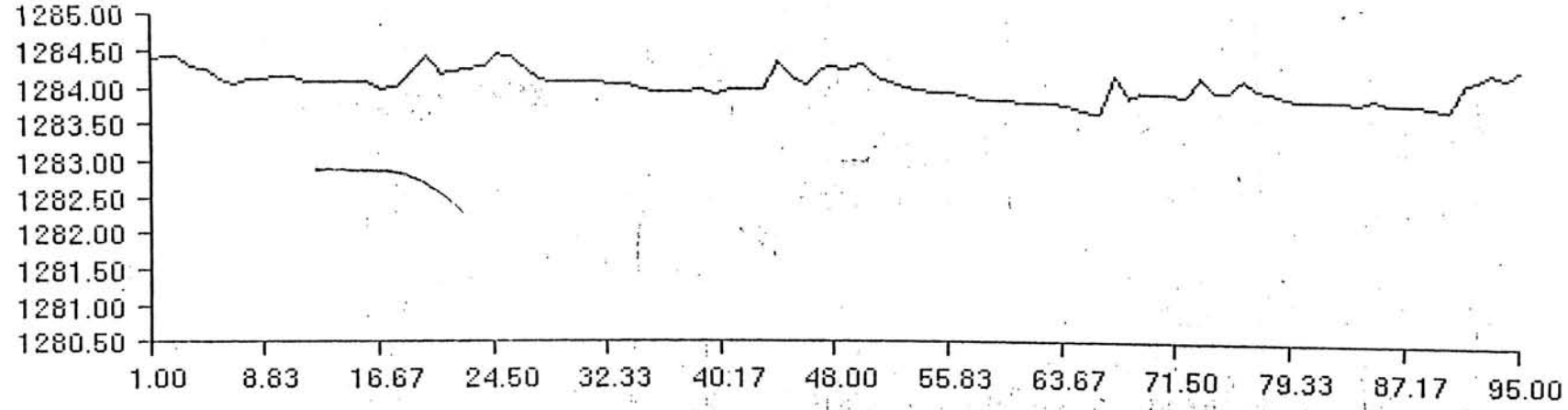
Interval = 1 hr.
19 days
8/25/93
15:08

808 956-6482



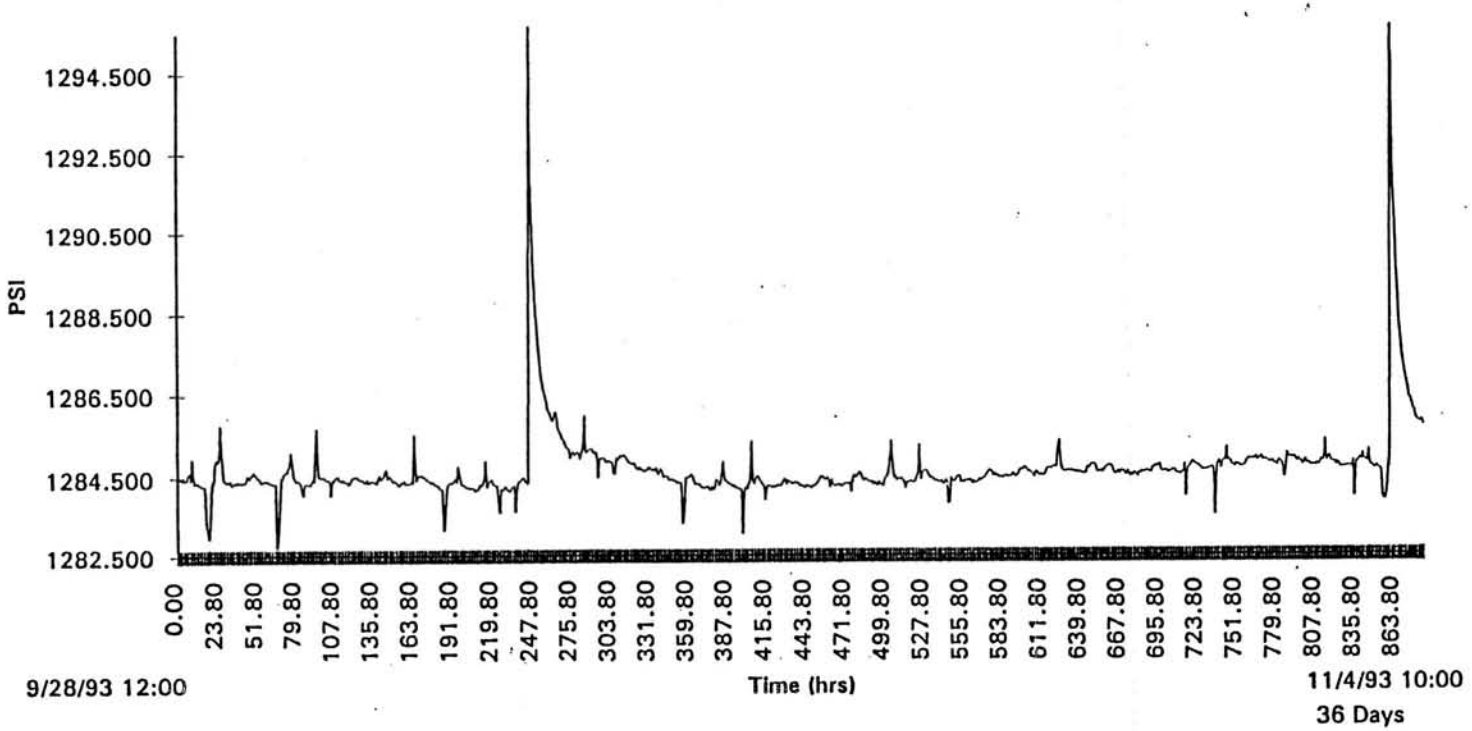
Interval = 1 hr.
30 days
9/24/93 11:42
WHP = 196 psi

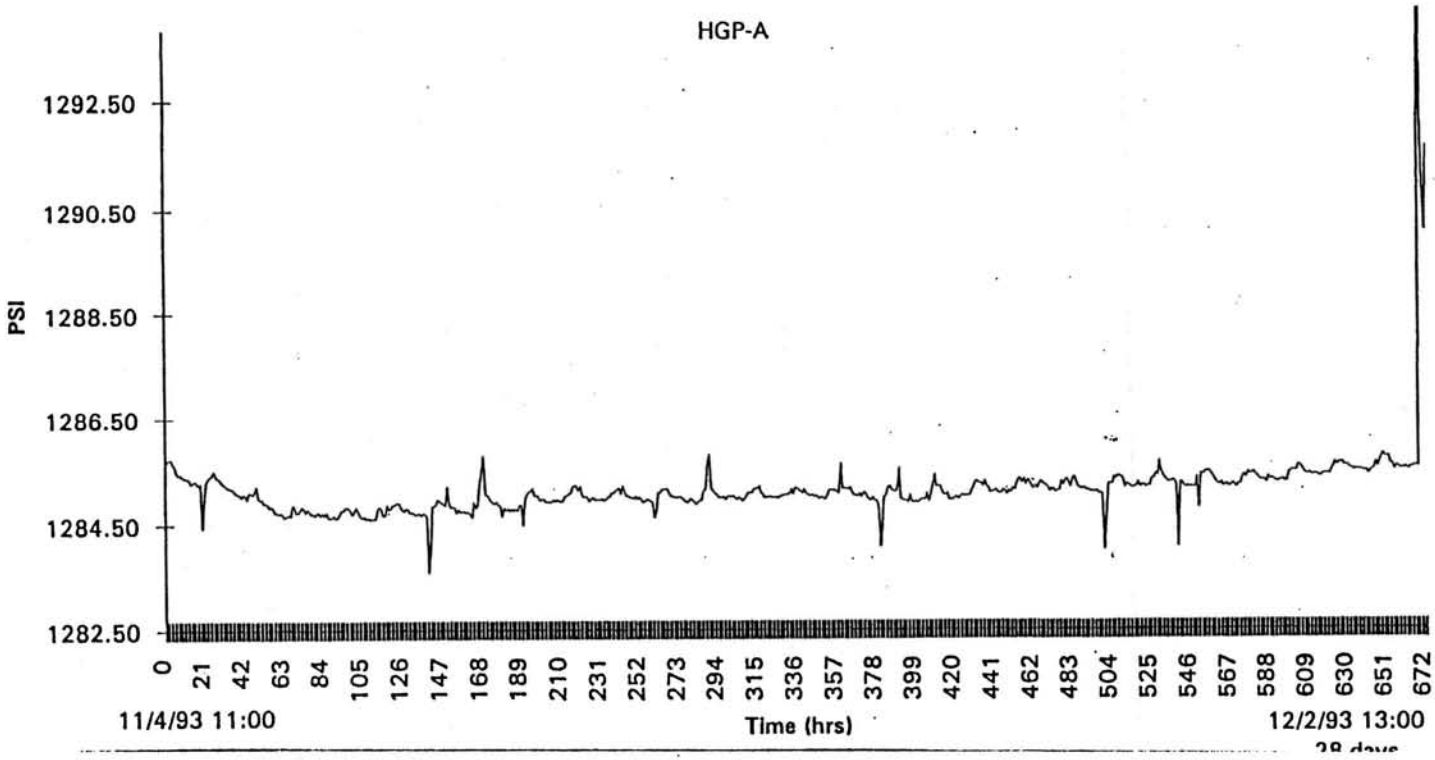
Jon Thomas

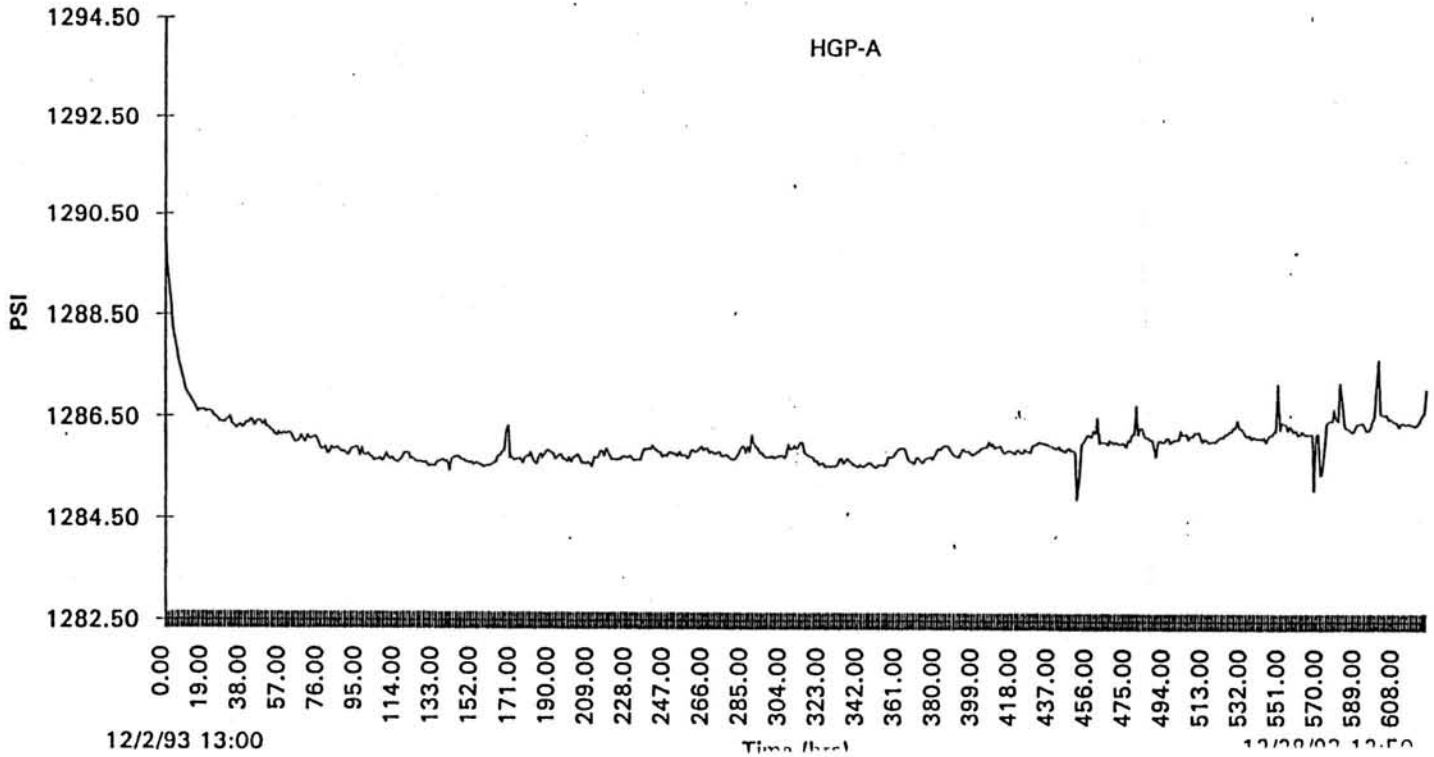


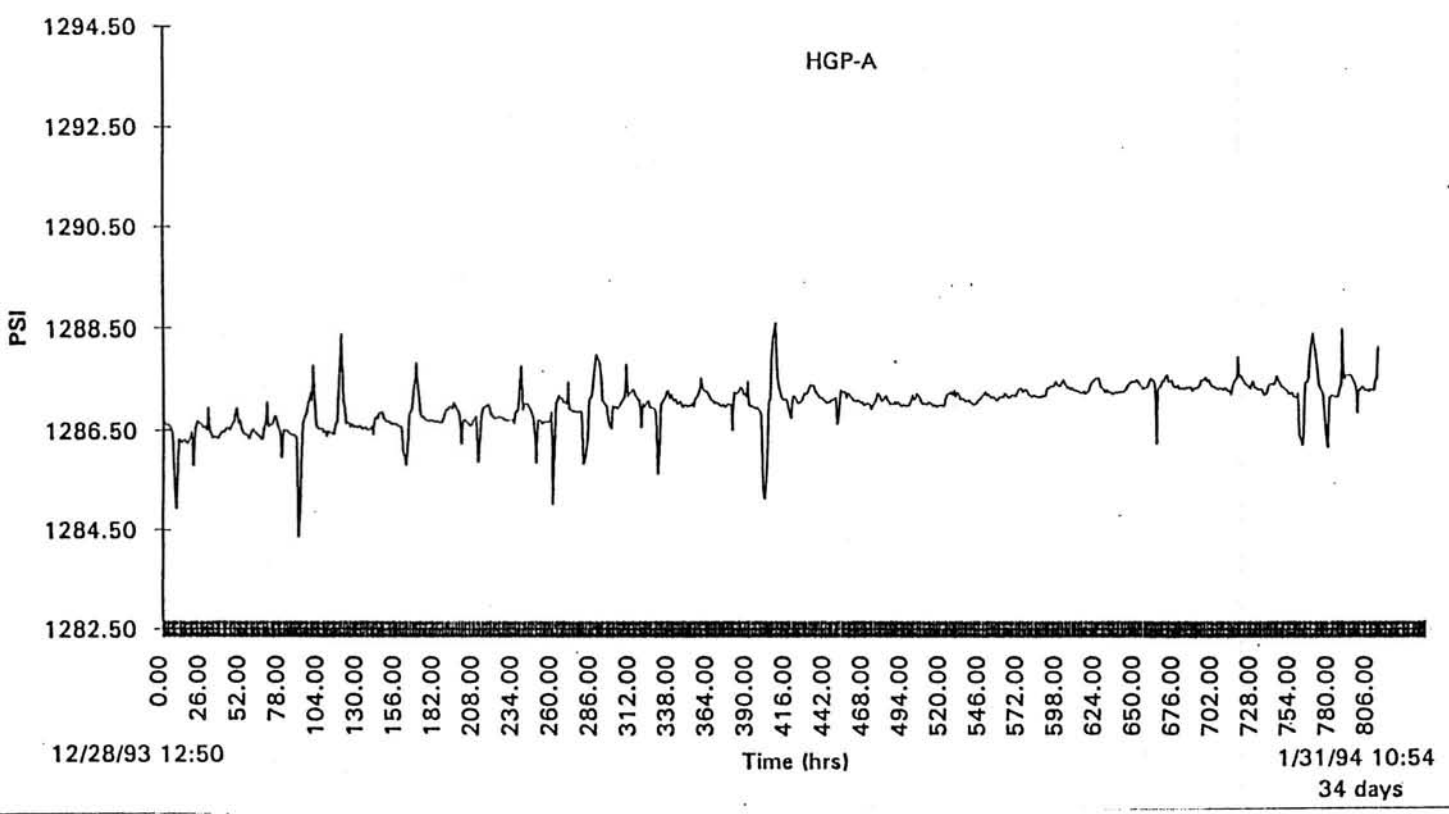
Interval = 1 hr.
3 days
9/28/93 11:00
WHP = 206+

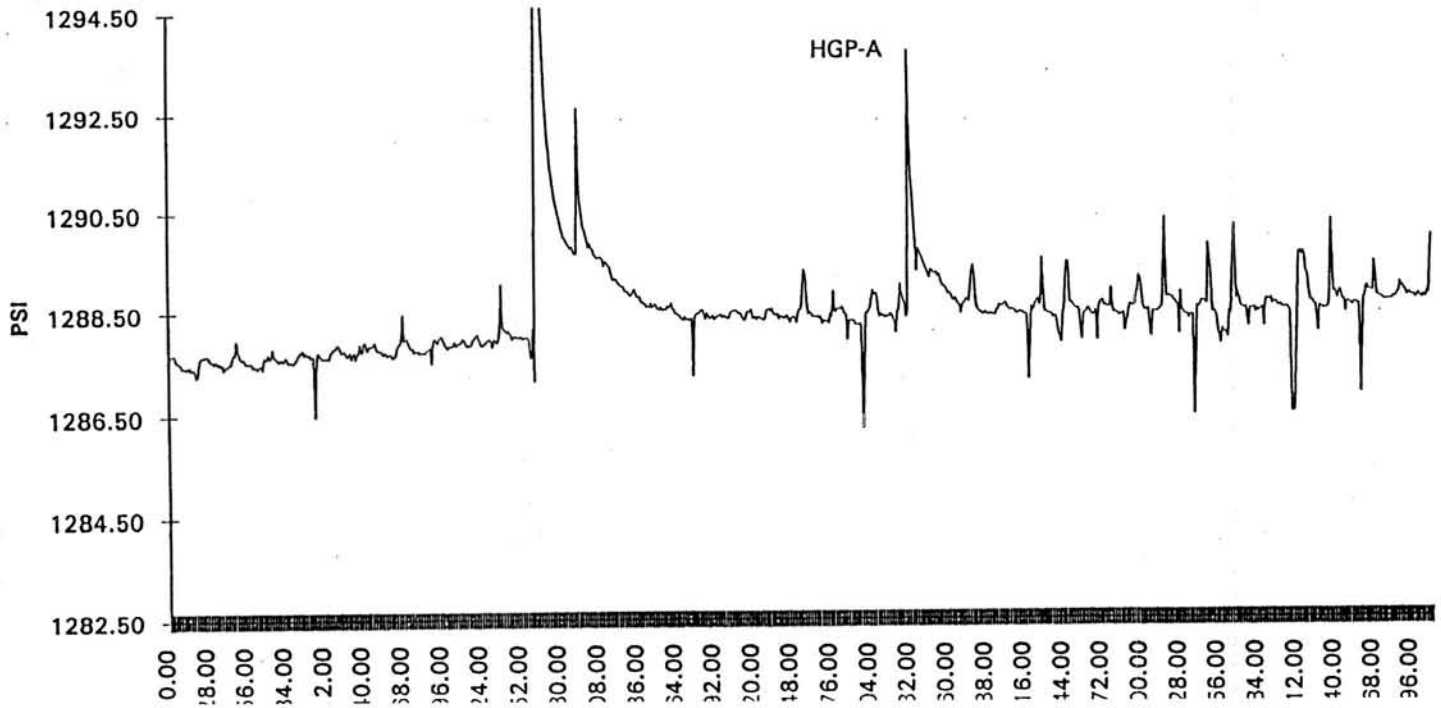
HGPA

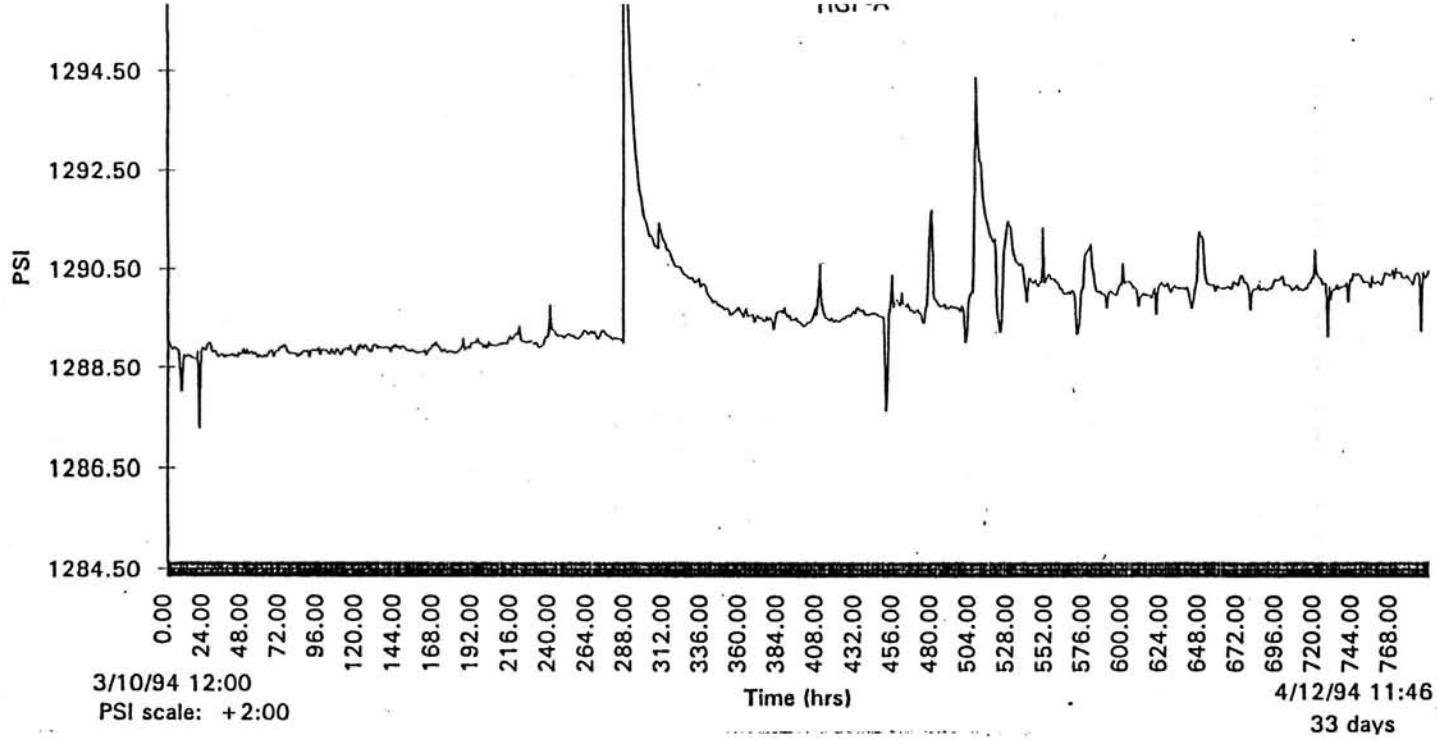


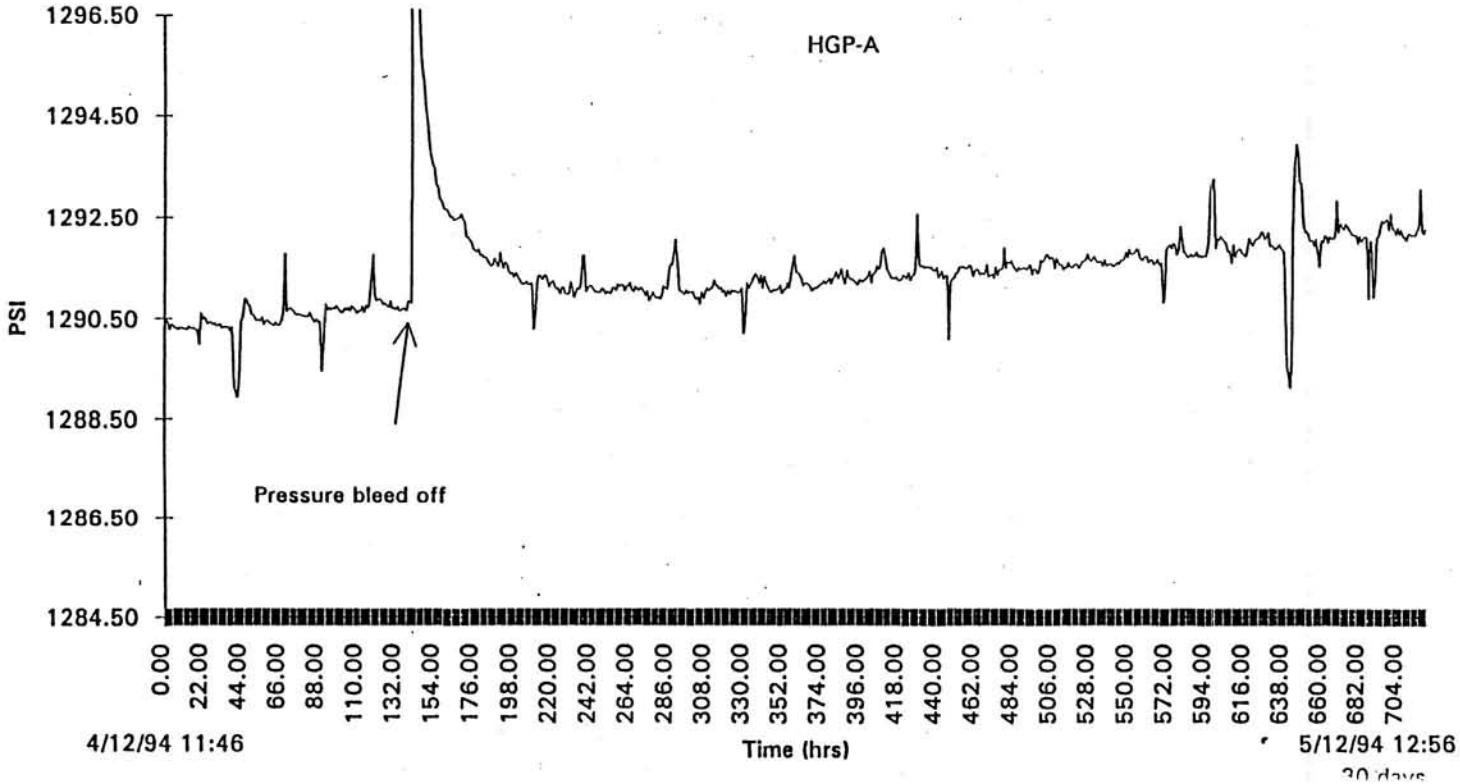

HGP-A
PSI
1292.50
1290.50
1288.50
1286.50
1284.50
1282.50
0
21
42
63
84
105
126
147
168
189
210
231
252
273
294
315
336
357
378
399
420
441
462
483
504
525
546
567
588
609
630
651
672
11/4/93 11:00
Time (hrs)
12/2/93 13:00

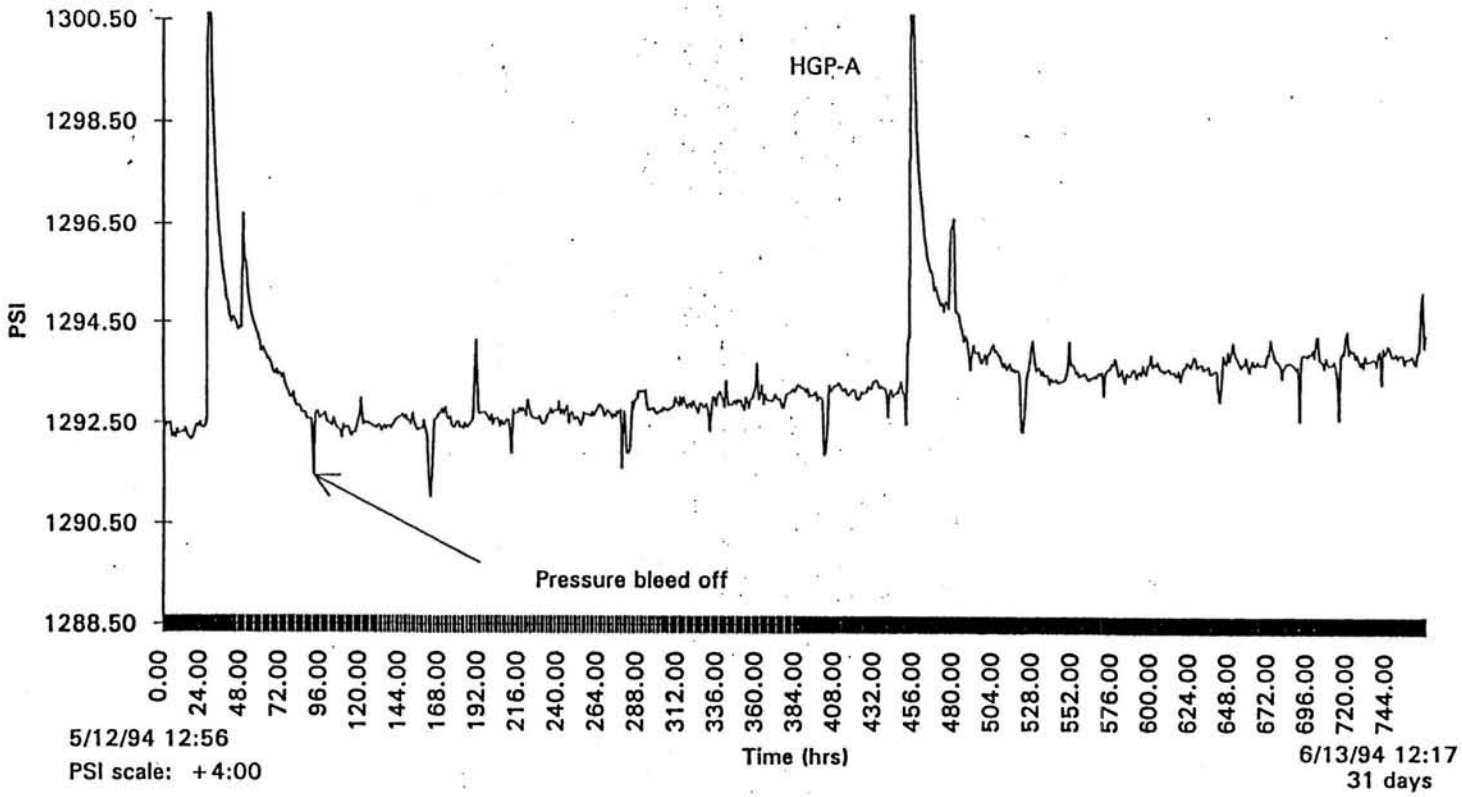

HGP-A
PSI
1294.50
1292.50
1290.50
1288.50
1286.50
1284.50
1282.50
0.00
19.00
38.00
57.00
76.00
95.00
114.00
133.00
152.00
171.00
190.00
209.00
228.00
247.00
266.00
285.00
304.00
323.00
342.00
361.00
380.00
399.00
418.00
437.00
456.00
475.00
494.00
513.00
532.00
551.00
570.00
589.00
608.00
12/2/93 13:00

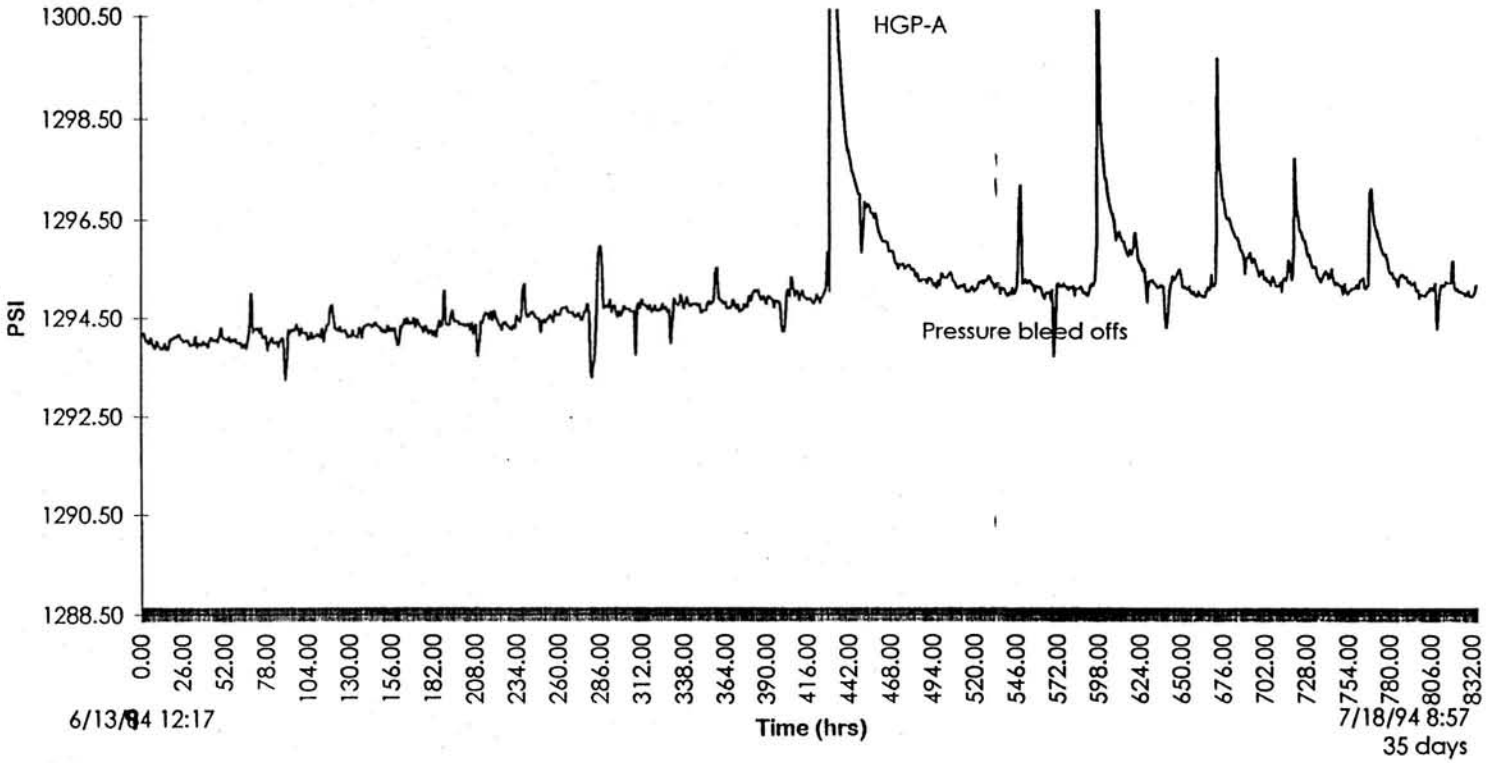

HGP-A
PSI
1294.50
1292.50
1290.50
1288.50
1286.50
1284.50
1282.50
0.00
26.00
52.00
78.00
104.00
130.00
156.00
182.00
208.00
234.00
260.00
286.00
312.00
338.00
364.00
390.00
416.00
442.00
468.00
494.00
520.00
546.00
572.00
598.00
624.00
650.00
676.00
702.00
728.00
754.00
780.00
806.00
12/28/93 12:50
Time (hrs)
1/31/94 10:54
34 days


HGP-A
PSI
1294.50
1292.50
1290.50
1288.50
1286.50
1284.50
1282.50


1294.50
1292.50
1290.50
1288.50
1286.50
1284.50
PSI
0.00
24.00
48.00
72.00
96.00
120.00
144.00
168.00
192.00
216.00
240.00
264.00
288.00
312.00
336.00
360.00
384.00
408.00
432.00
456.00
480.00
504.00
528.00
552.00
576.00
600.00
624.00
648.00
672.00
696.00
720.00
744.00
768.00
3/10/94 12:00
PSI scale: +2:00
Time (hrs)
4/12/94 11:46
33 days

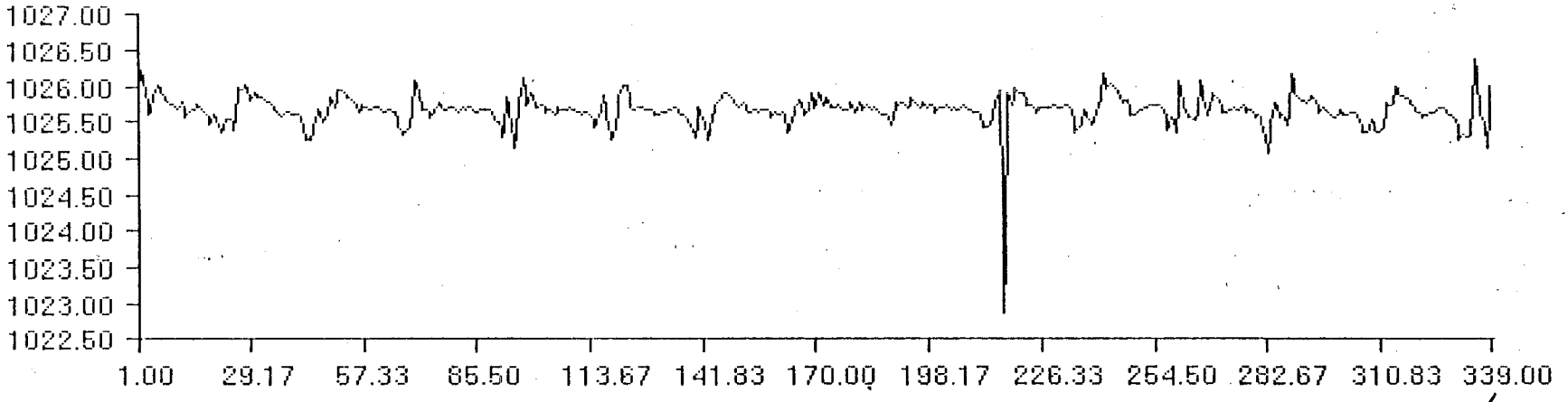

HGP-A
1296.50
1294.50
1292.50
1290.50
1288.50
1286.50
1284.50
PSI
Pressure bleed off
0.00
22.00
44.00
66.00
88.00
110.00
132.00
154.00
176.00
198.00
220.00
242.00
264.00
286.00
308.00
330.00
352.00
374.00
396.00
418.00
440.00
462.00
484.00
506.00
528.00
550.00
572.00
594.00
616.00
638.00
660.00
682.00
704.00
4/12/94 11:46
Time (hrs)
5/12/94 12:56


HGP-A
PSI
1300.50
1298.50
1296.50
1294.50
1292.50
1290.50
1288.50
Pressure bleed off
0.00
24.00
48.00
72.00
96.00
120.00
144.00
168.00
192.00
216.00
240.00
264.00
288.00
312.00
336.00
360.00
384.00
408.00
432.00
456.00
480.00
504.00
528.00
552.00
576.00
600.00
624.00
648.00
672.00
696.00
720.00
744.00
5/12/94 12:56
PSI scale: +4:00
Time (hrs)
6/13/94 12:17
31 days


HGP-A
Pressure bleed offs
PSI
1300.50
1298.50
1296.50
1294.50
1292.50
1290.50
1288.50
0.00
26.00
52.00
78.00
104.00
130.00
156.00
182.00
208.00
234.00
260.00
286.00
312.00
338.00
364.00
390.00
416.00
442.00
468.00
494.00
520.00
546.00
572.00
598.00
624.00
650.00
676.00
702.00
728.00
754.00
780.00
806.00
832.00
6/13/94 12:17
Time (hrs)
7/18/94 8:57
35 days

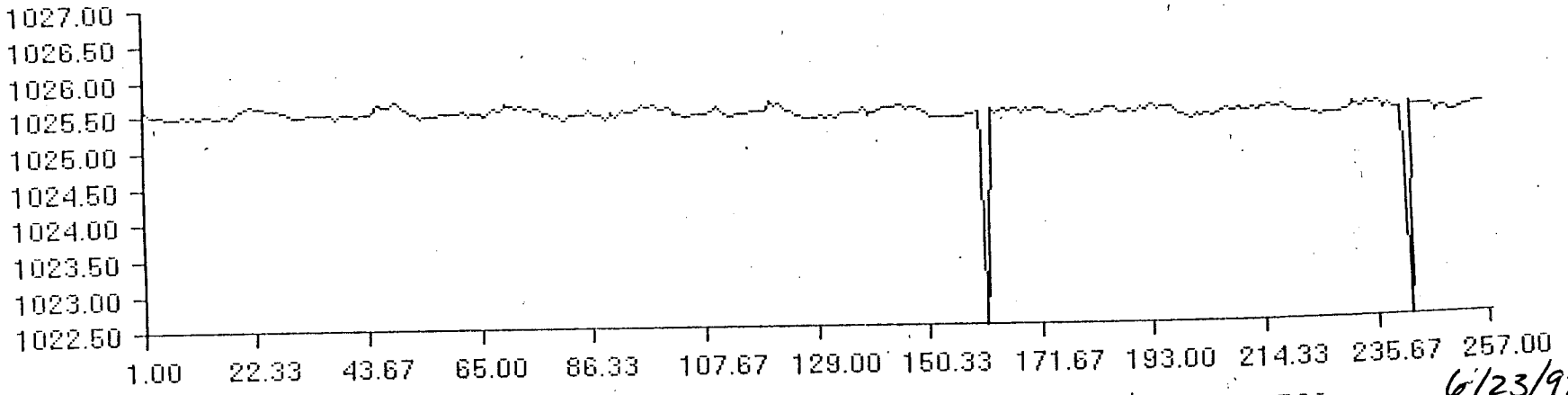
APPENDIX II

Graph of SOH-1 Pressure Data



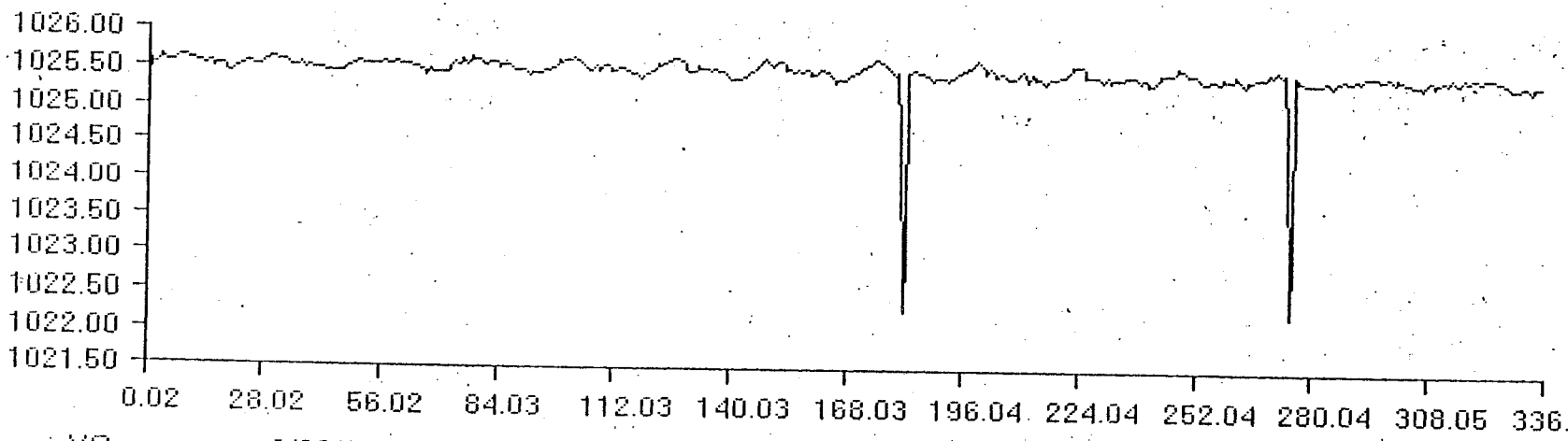
VS 4/20/1992 13: 0: 1 1BKASOH1.SUR 5/4/92

<S=SCALE> <M=MARK POINTS> <P=PRINT> INTERVAL=1 HR 4:07

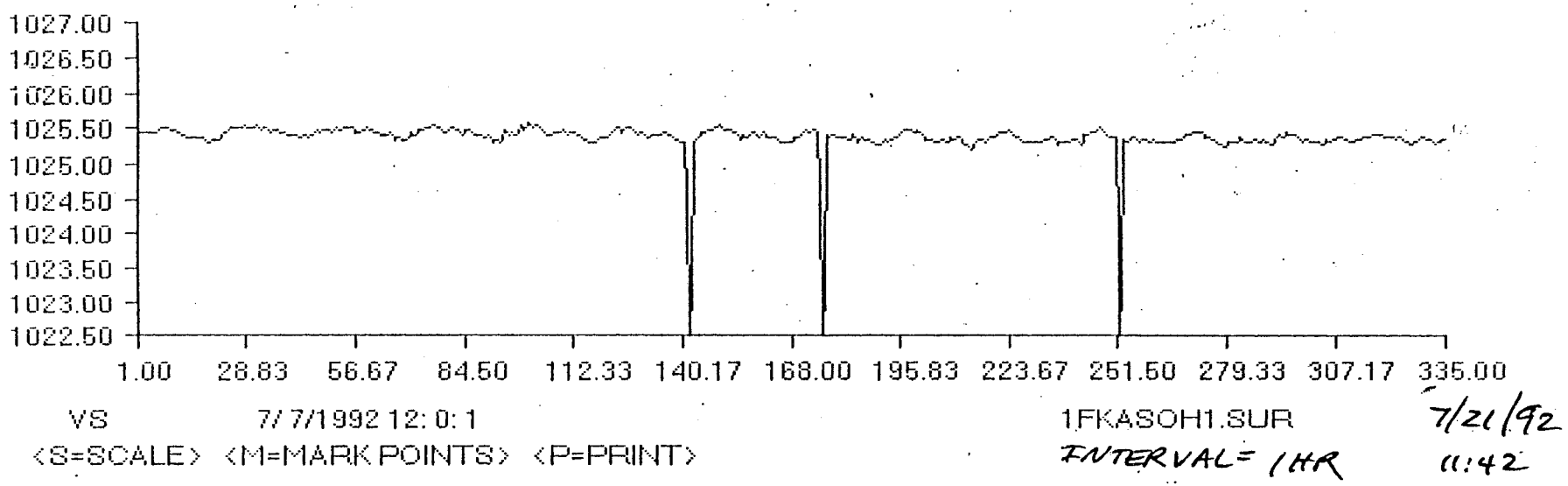


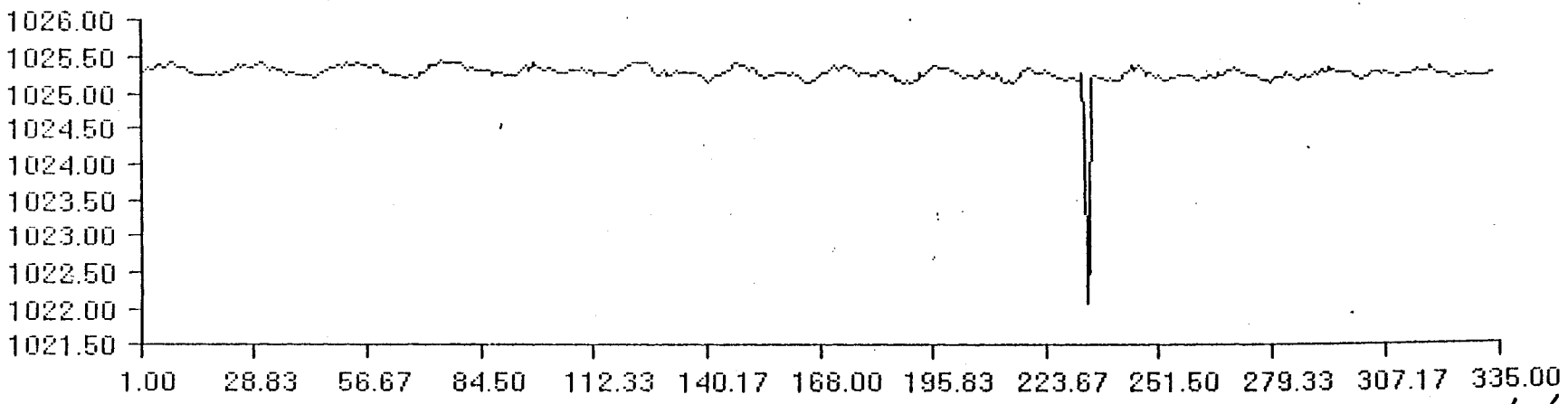
VS 6/12/1992 17: 0: 1 1DKASOH1.S00 6/23/92

<S=SCALE> <M=MARK POINTS> <P=PRINT> INTERVAL = 1 HR 10:34


1026.00
1025.50
1025.00
1024.50
1024.00
1023.50
1023.00
1022.50
1022.00
1021.50
0.02
28.02
56.02
84.03
112.03
140.03
168.03
196.04
224.04
252.04
280.04
308.05
336.05
VS
6/23/1992 10:57: 1
<S=SCALE> <M=MARK POINTS> <P=PRINT>
a:1EKASOH1.SUR
Interval = 1 hr
7/7/92
11:24

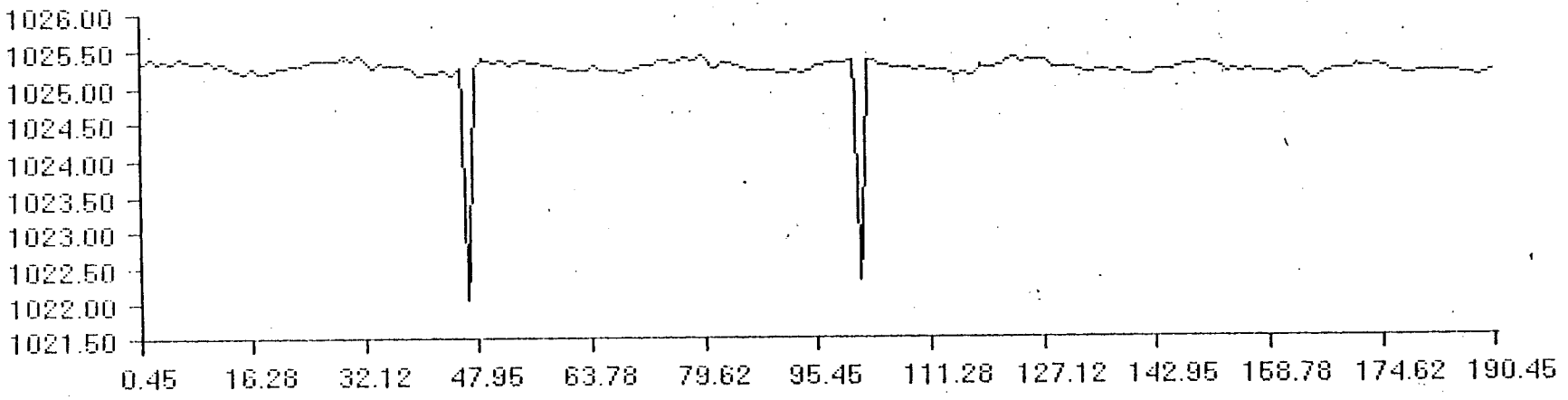
6/23/92 purge


1027.00
1026.50
1026.00
1025.50
1025.00
1024.50
1024.00
1023.50
1023.00
1022.50
1.00
28.83
56.67
84.50
112.33
140.17
168.00
195.83
223.67
251.50
279.33
307.17
335.00
VS
7/ 7/1992 12: 0: 1
<S=SCALE> <M=MARK POINTS> <P=PRINT>
1FKASOH1.SUR
INTERVAL = 1HR
7/21/92
11:42



VS 7/21/1992 12: 0: 1 1GKASOH1.SUR 8/4/92

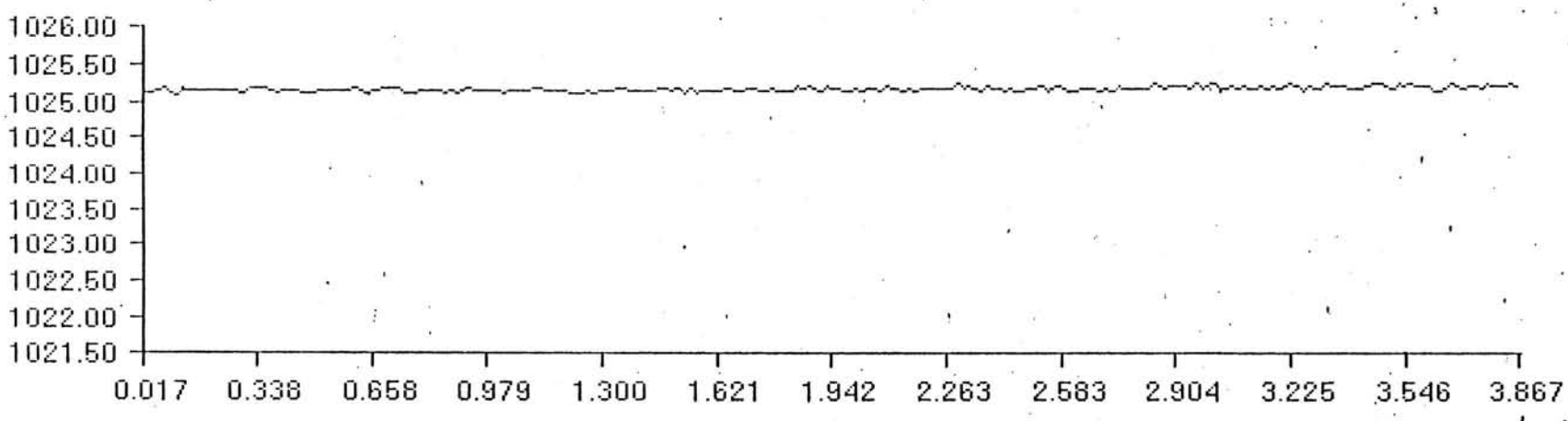
<S=SCALE> <M=MARK POINTS> <P=PRINT> INTERVAL=1HR 11:11



VS 8/ 4/1992 11:33: 1 1HKASOH1.SUR 8/12/92

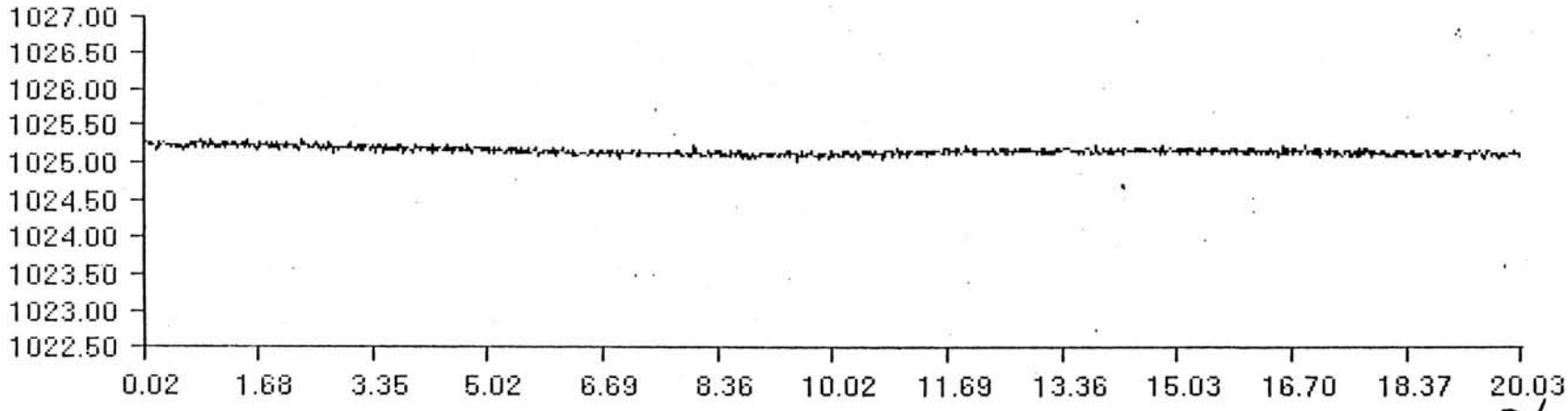
<S=SCALE> <M=MARK POINTS> <P=PRINT> Interval = 1 hr 10:

8/4/92
PURGE



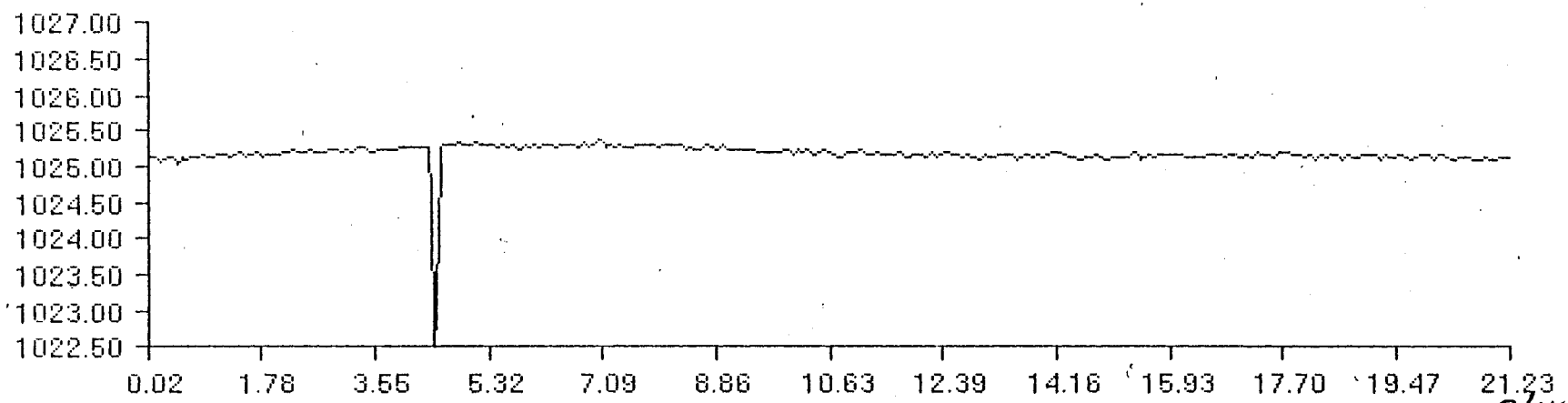
interval = 1 min

8/12/92
14:



INTERVAL = 1 MIN

8/13/92
10:52

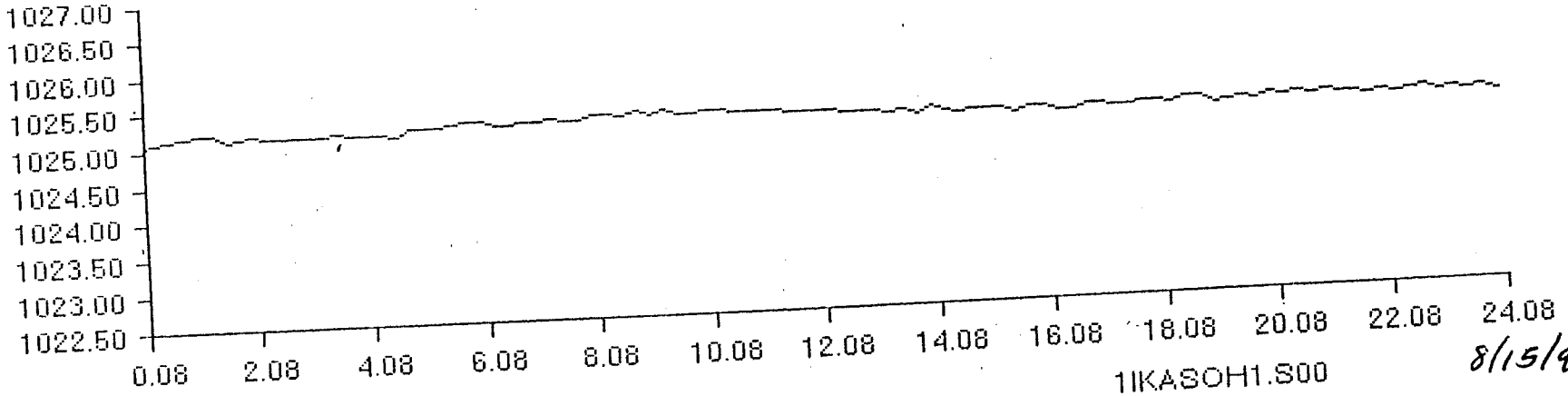


VS 8/13/1992 10:51: 1 1IKASOH1.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

8/14/92
8:07

INTERVAL = 5 MIN



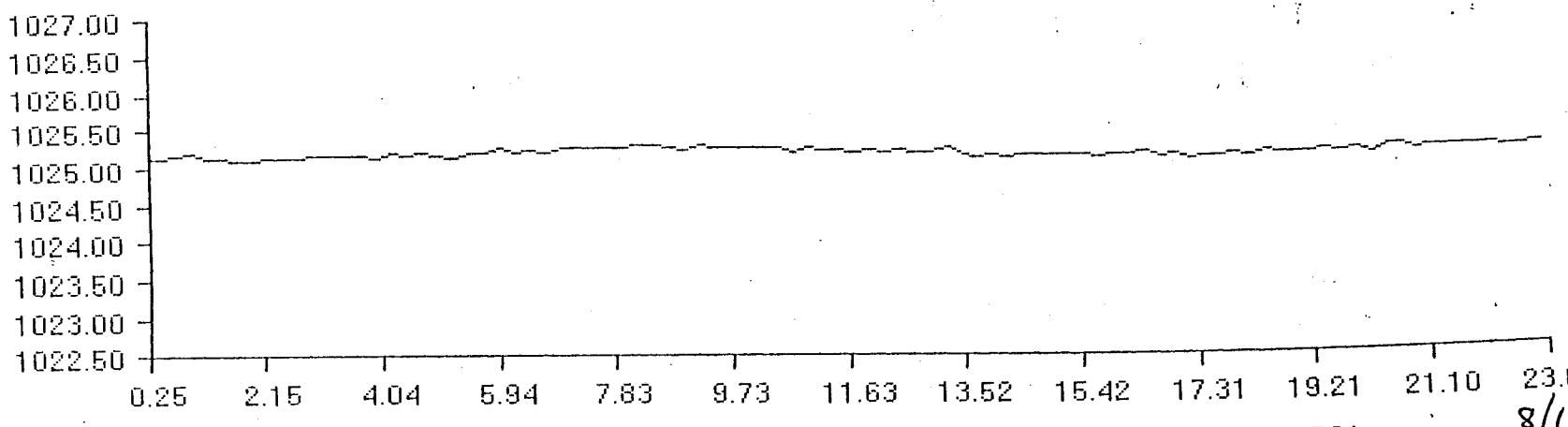
VS 8/14/1992 8:10: 1 1IKASOH1.S00

<S=SCALE> <M=MARK POINTS> <P=PRINT>

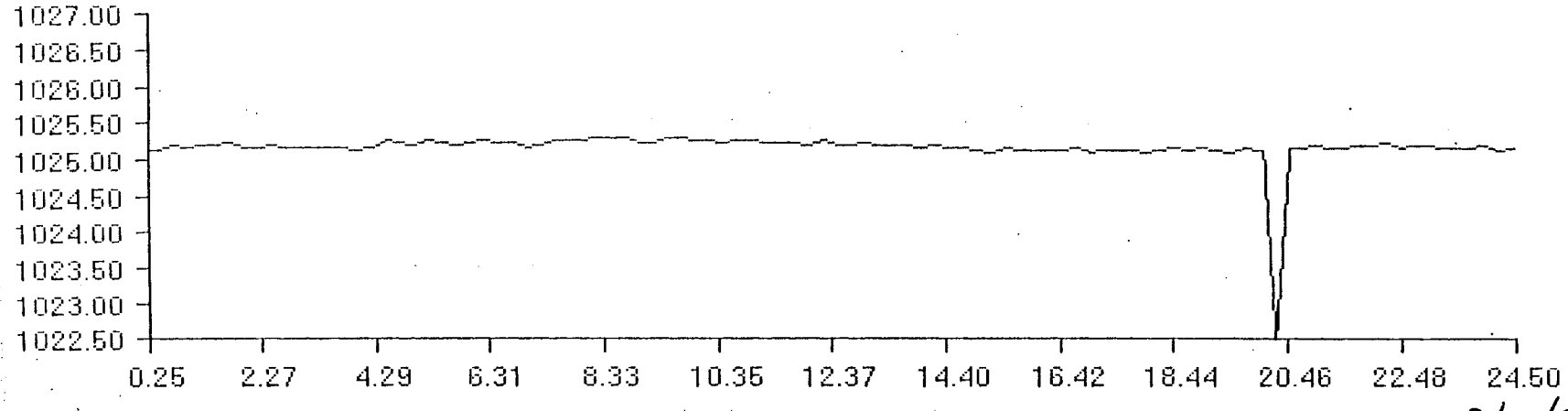
8/15/92
8:17

INTERVAL = 15 MIN

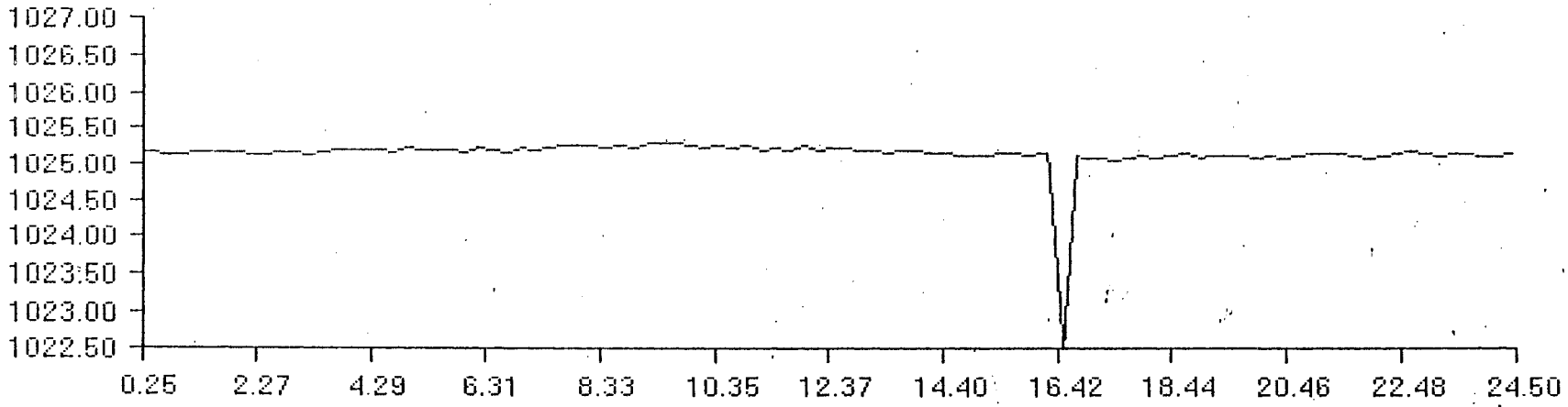
2



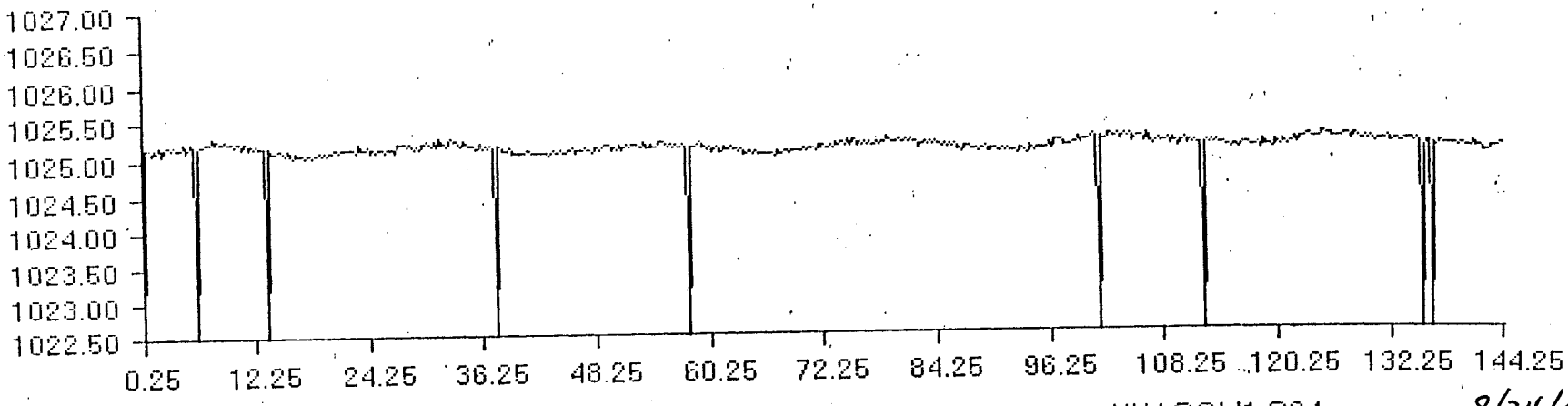
8/16/92
7:43



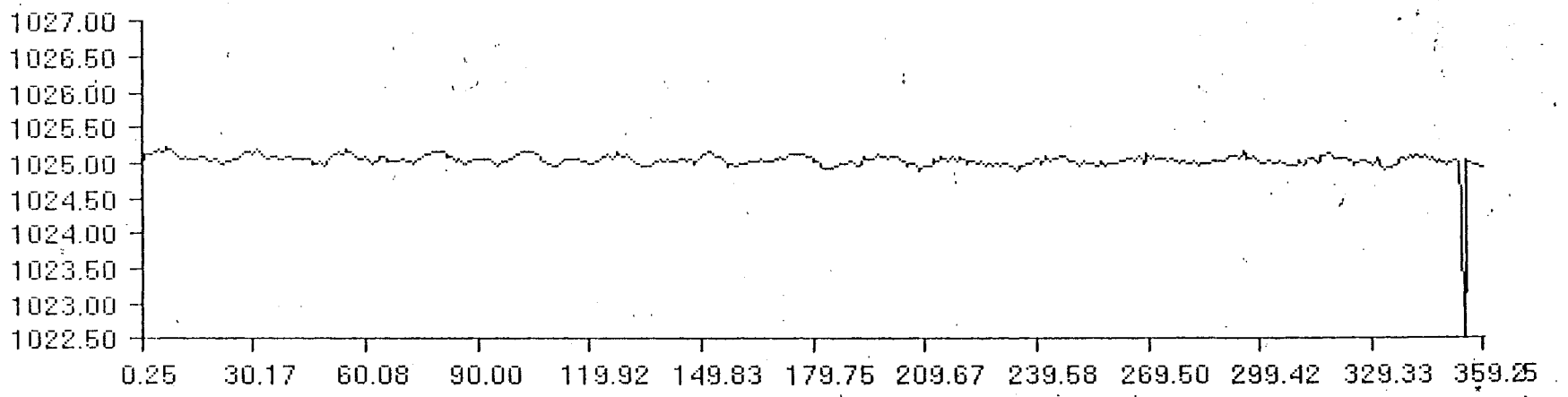
8/17/92
8:16



8/18/92
9:07

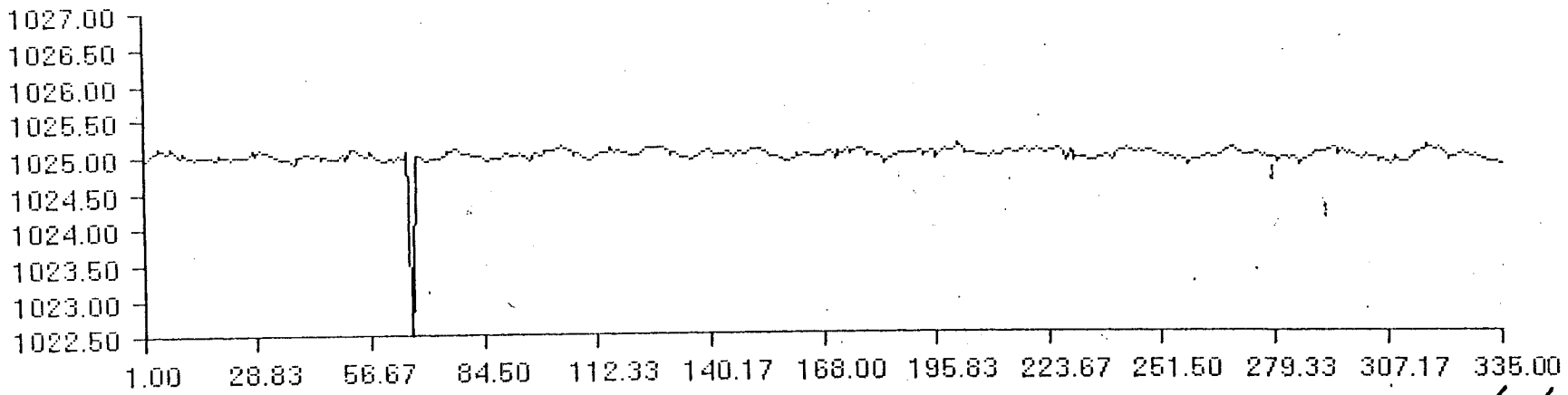


8/24/92
9:32



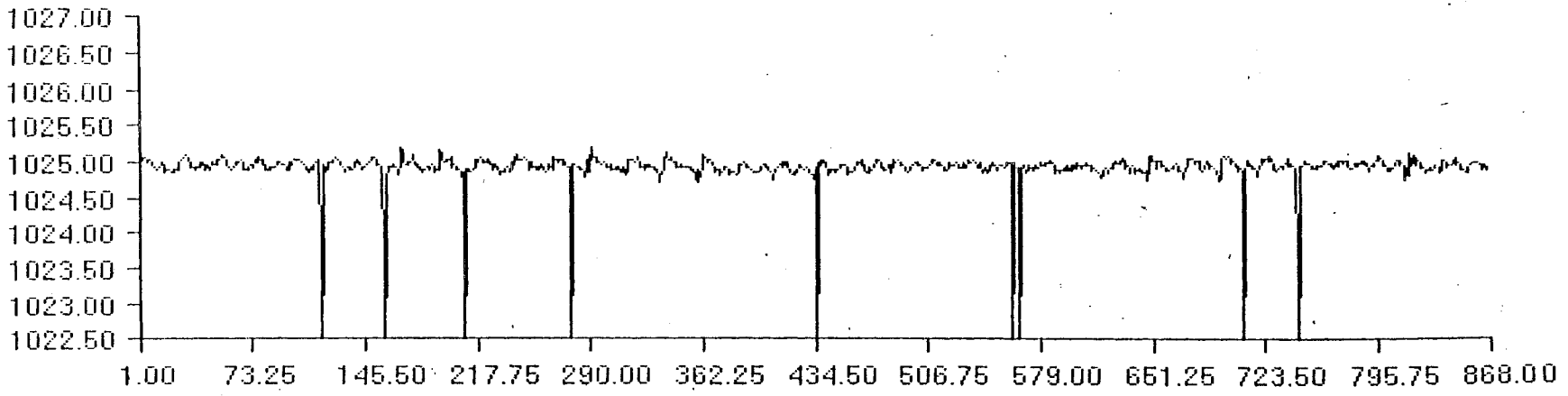
VS 8/24/1992 9:45: 1 1JKASOH1.SUR 9/8/92

<S=SCALE> <M=MARK POINTS> <P=PRINT> INTERVAL = 1 HR 9:34



VS 9/ 8/1992 10: 0: 1 1KKASOH1.SUR 9/22/92

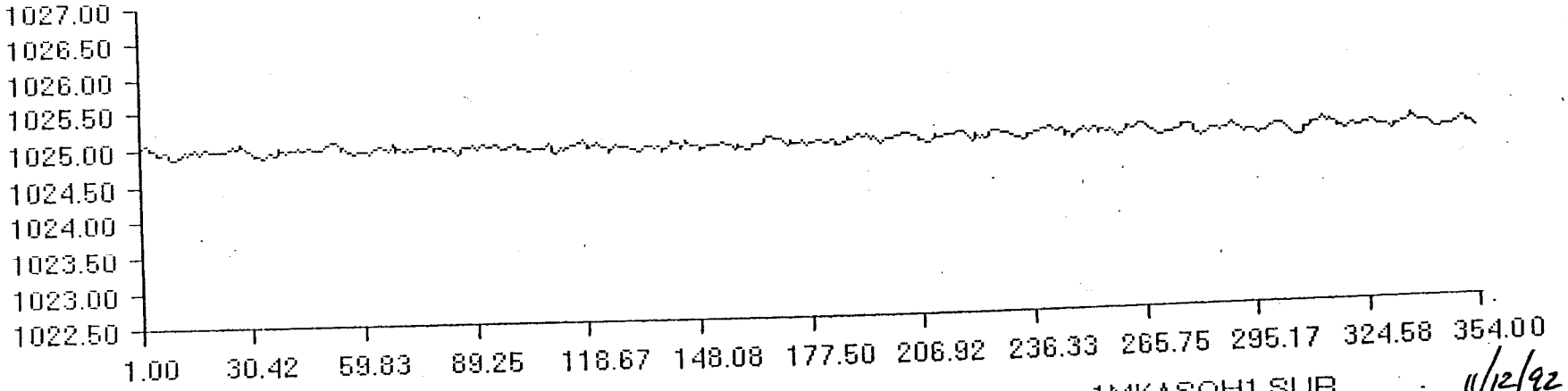
<S=SCALE> <M=MARK POINTS> <P=PRINT> INTERVAL = 1 HR 9:22



VS 9/22/1992 10: 0: 1
<S=SCALE> <M=MARK POINTS> <P=PRINT>

1LKASOH1.SUR
INTERVAL = 1 HR
36 DAYS

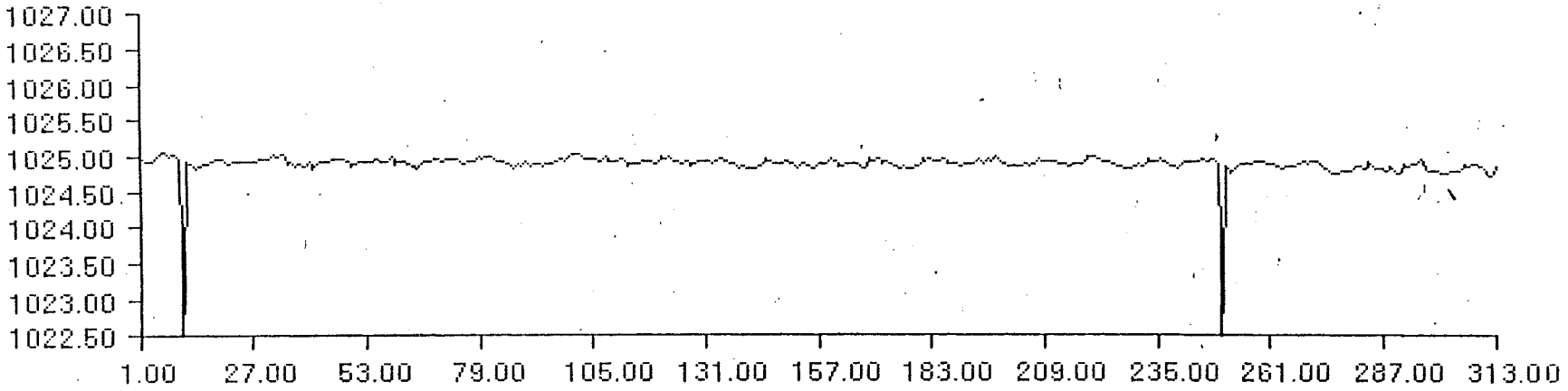
10/28/92
14:22



VS 10/28/1992 15: 0: 1
<S=SCALE> <M=MARK POINTS> <P=PRINT>

1MKASOH1.SUR
INTERVAL = 1 HR
15 DAYS

11/12/92
9:15

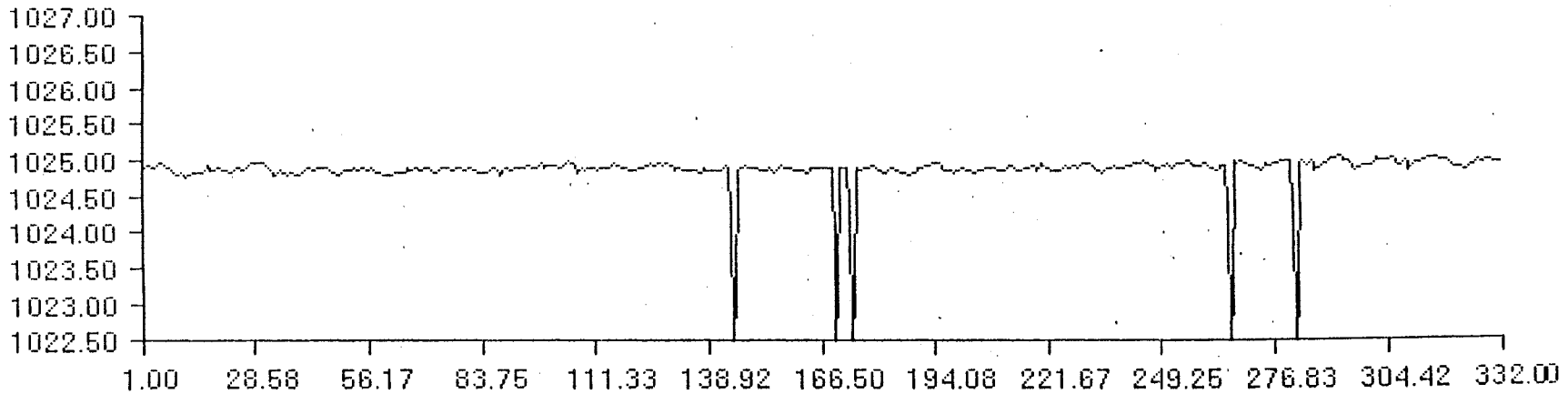


VS 11/12/1992 10: 0: 1 1NKASOH1.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

INTERVAL = 1 HR 11/25/92

13 DAYS 11:29

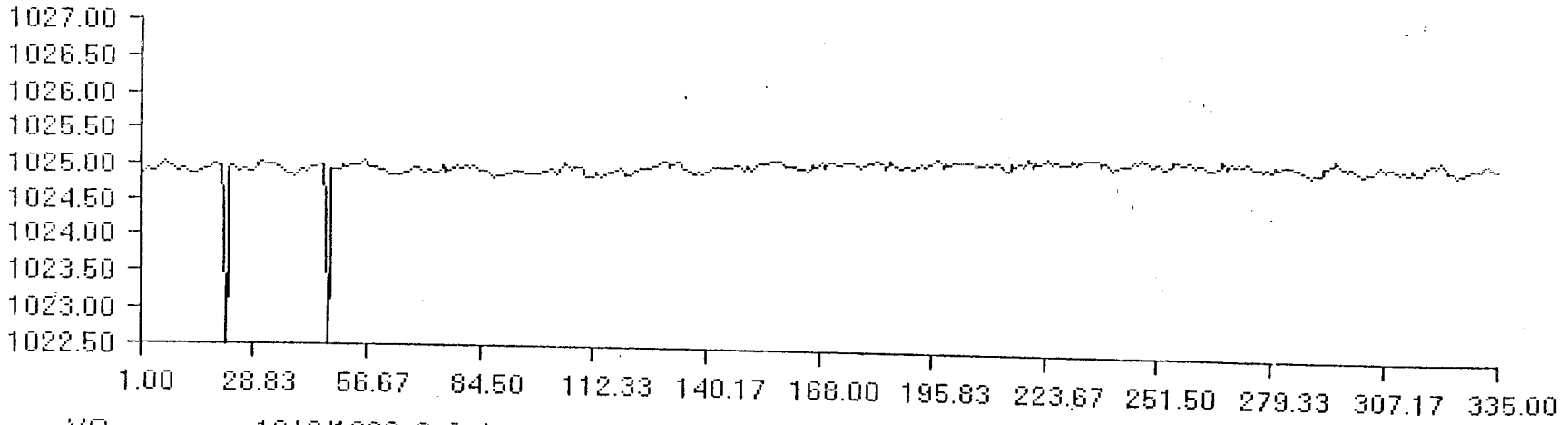


VS 11/25/1992 12: 0: 1 1OKASOH1.SUR

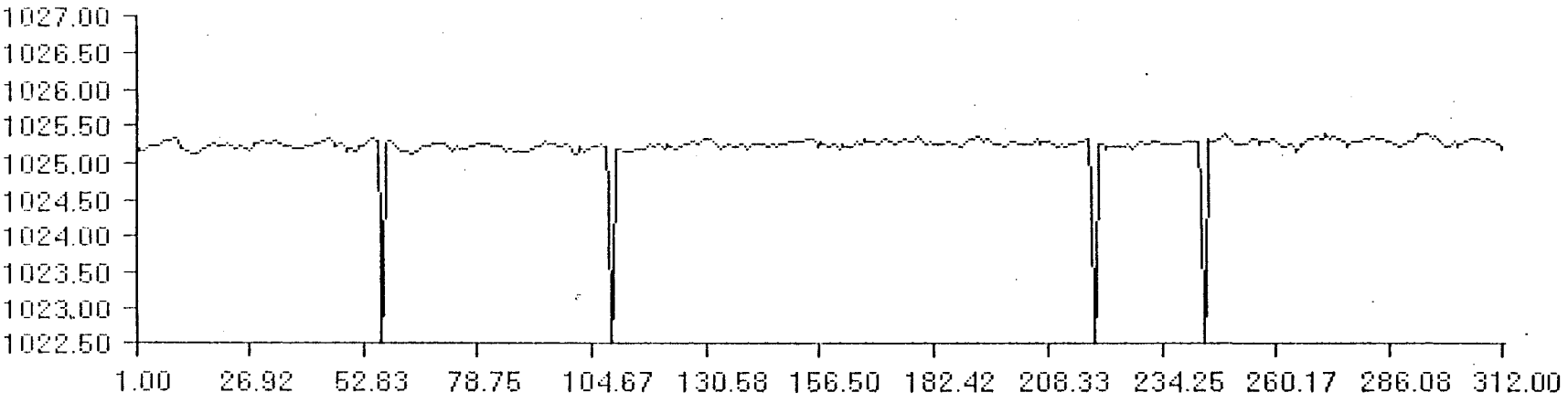
<S=SCALE> <M=MARK POINTS> <P=PRINT>

INTERVAL = 1 HR 12/9/92

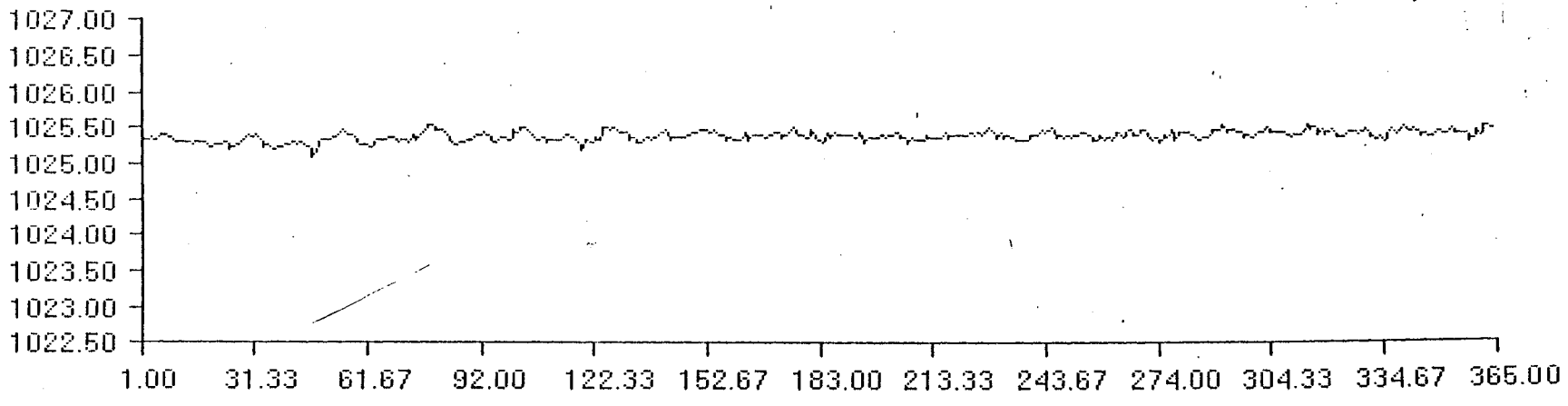
14 DAYS 8:41



12/23/92
8:38



1/5/93
9:59



VS 1/5/1993 10:0:1 1RKASOH1.SUR

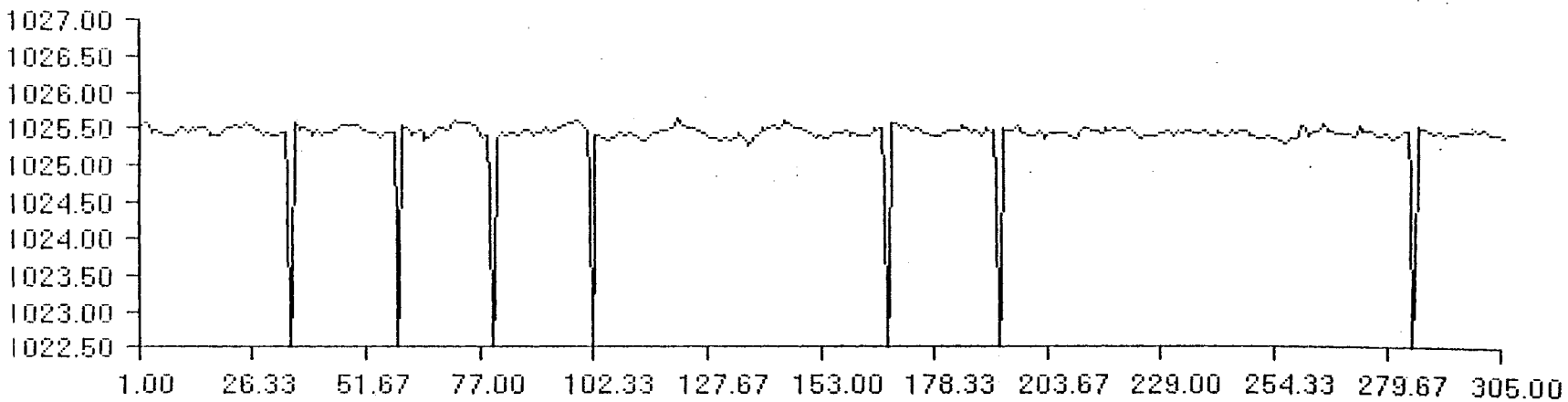
<S=SCALE> <M=MARK POINTS> <P=PRINT>

INTERVAL = 1 HR

15 DAYS

1/20/93

15:16



VS 1/20/1993 16:0:1 1SKASOH1.SUR

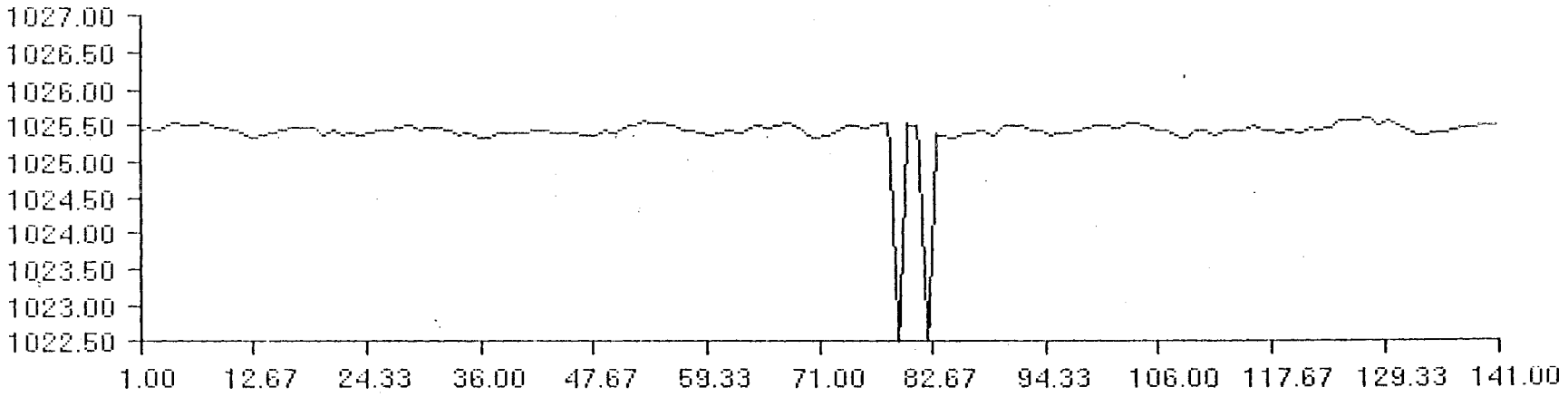
<S=SCALE> <M=MARK POINTS> <P=PRINT>

INTERVAL = 1 HR

13 DAYS

2/2/93

9:44

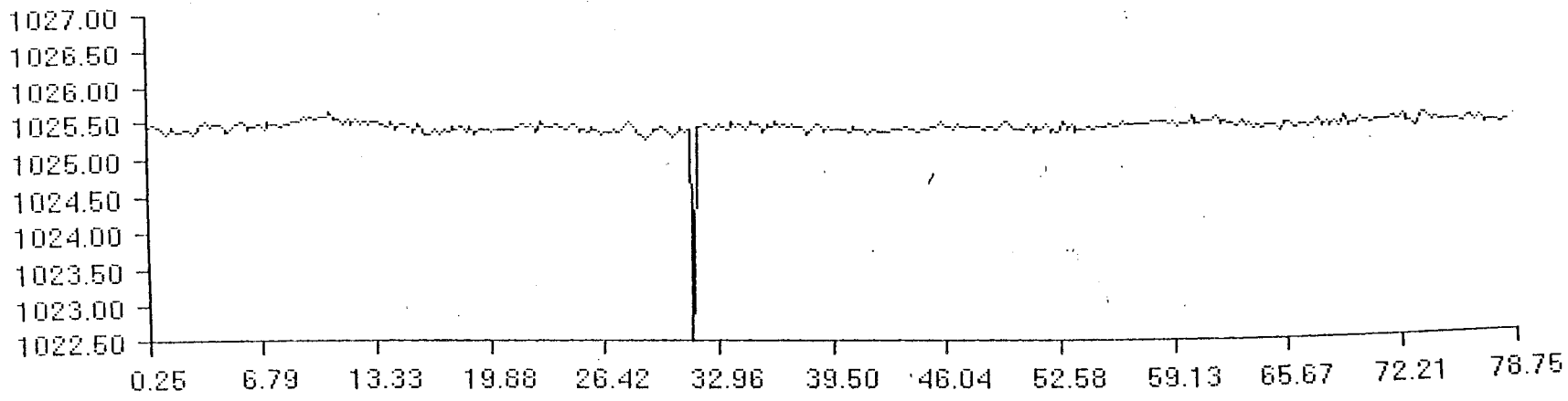


VS 2/ 2/1993 10: 0: 1 1TKASOH1.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

INTERVAL= 1HR 2/8/93

6 DAYS 7:35

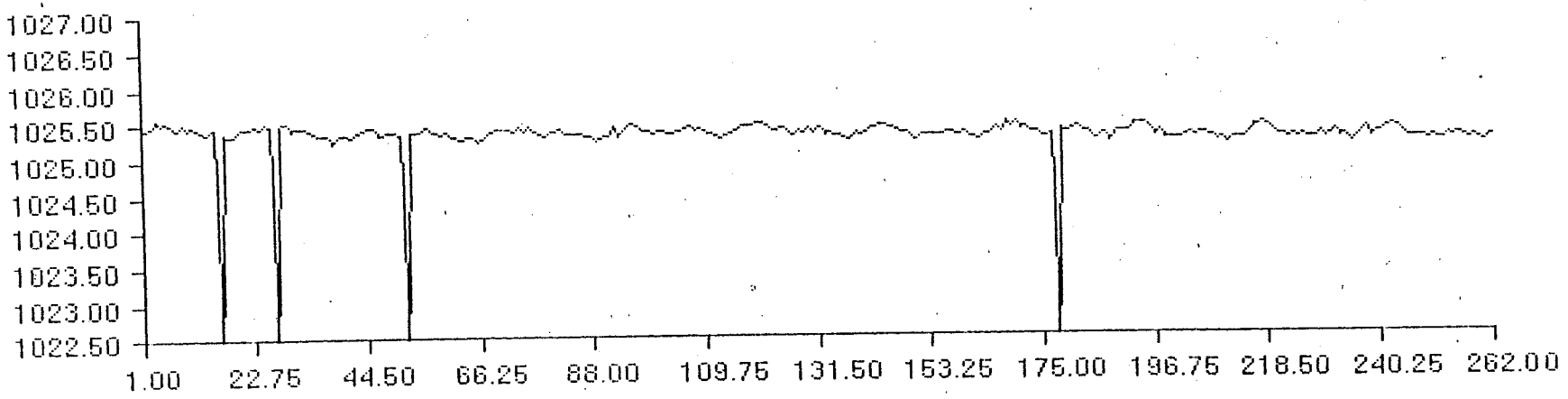


VS 2/ 8/1993 7:45: 1 1TKASOH1.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

INTERVAL= 15MIN 2/11/93

3 DAYS 14:34

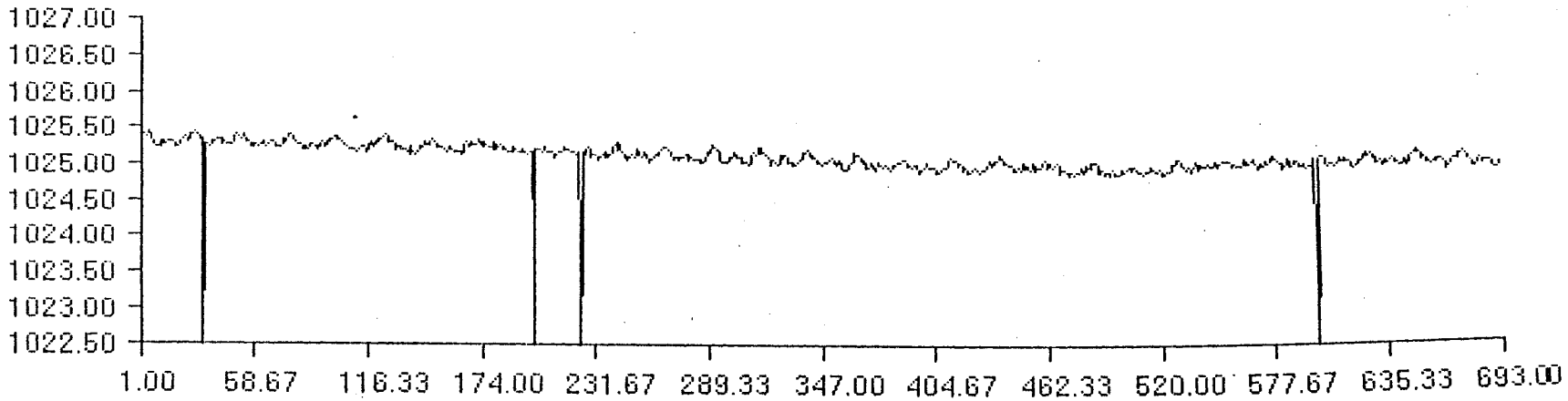


VS 2/11/1993 15: 0: 1 1UKASOH1.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

INTERVAL = 1 HR 2/22/93

11 DAYS

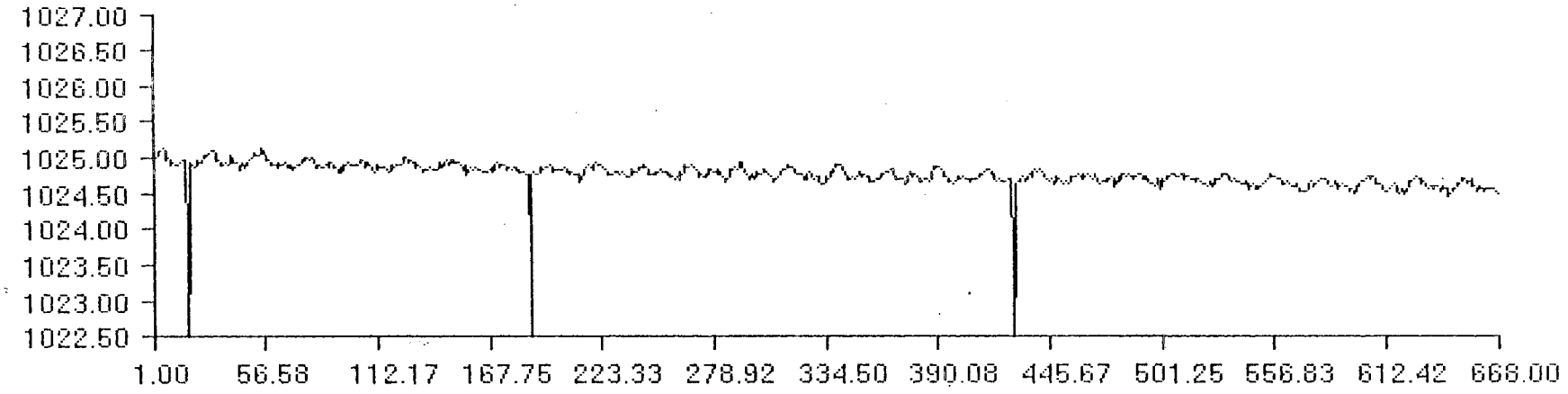


VS 2/22/1993 14: 0: 1 1VKASOH1.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

Interval = 1 hr 2/22/93

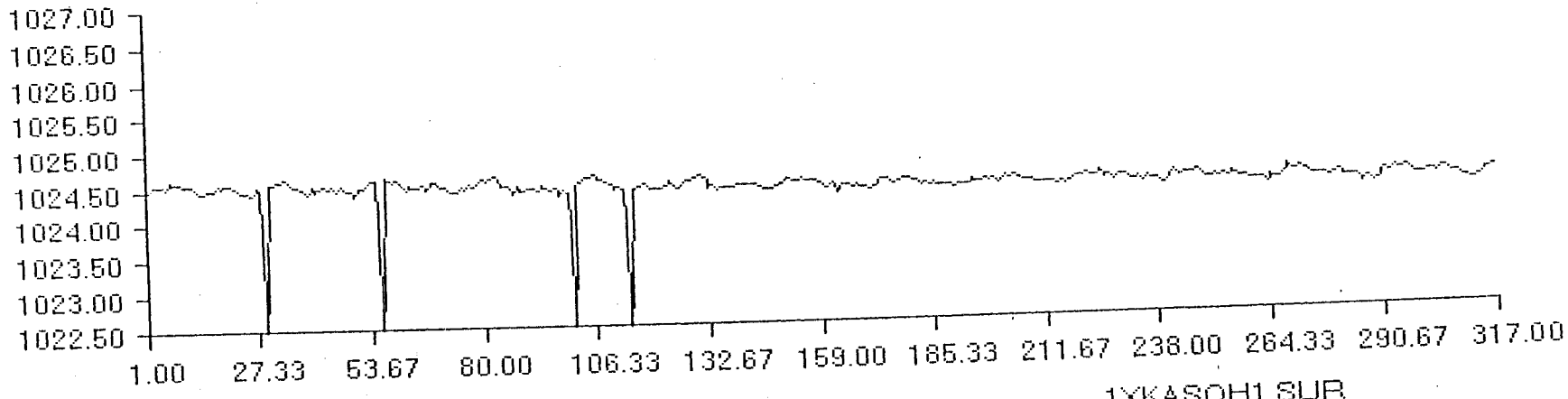
29 days 11:00



VS 3/23/1993 12: 0: 1 1WKASOH1.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

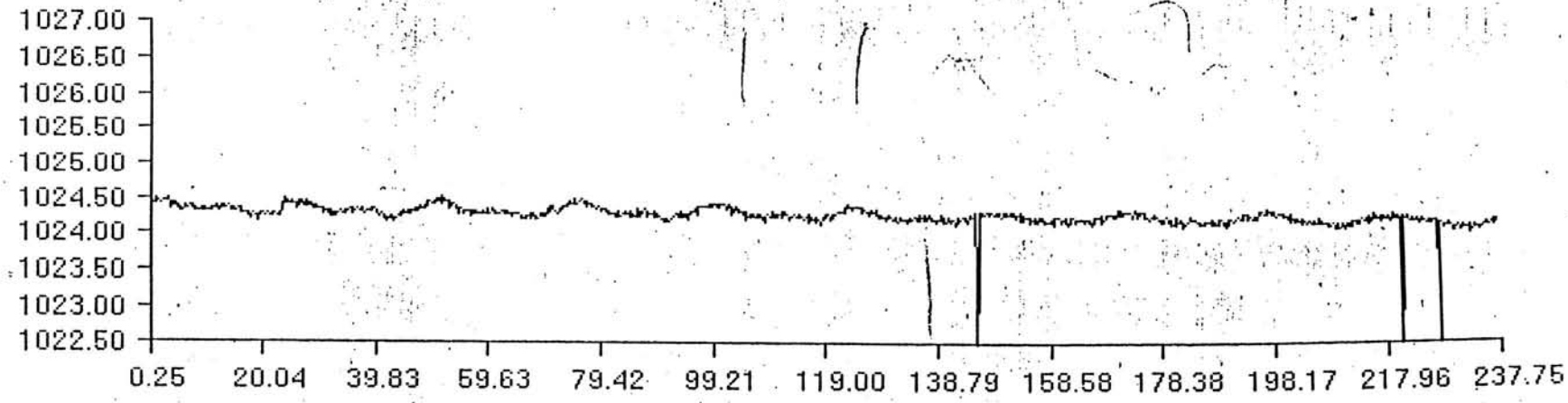
Interval = 1 hr
28 days
4/20/93
9:11a



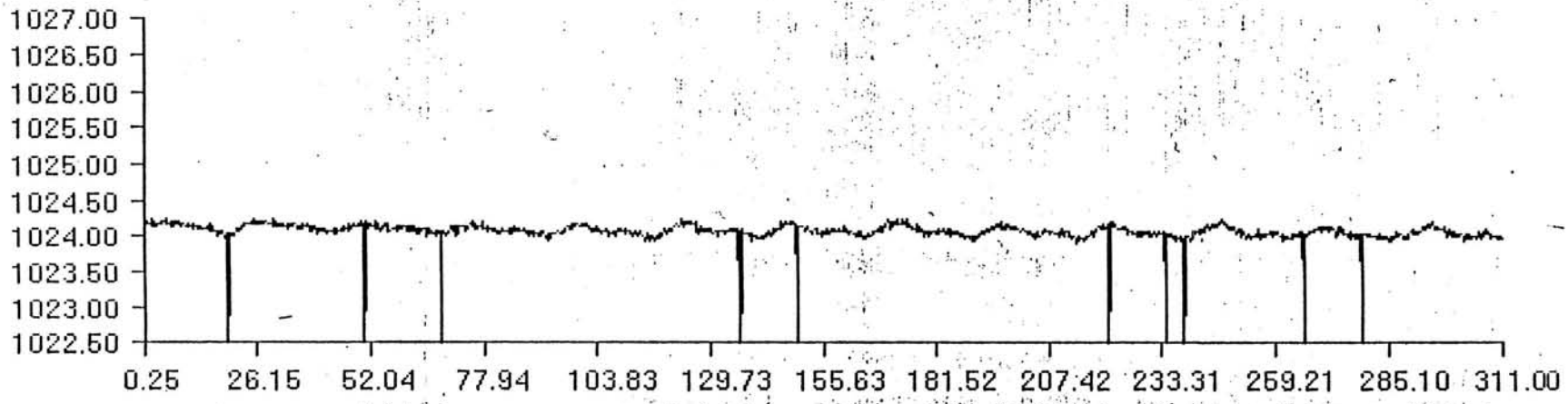
VS 4/20/1993 9: 0: 1 1XKASOH1.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

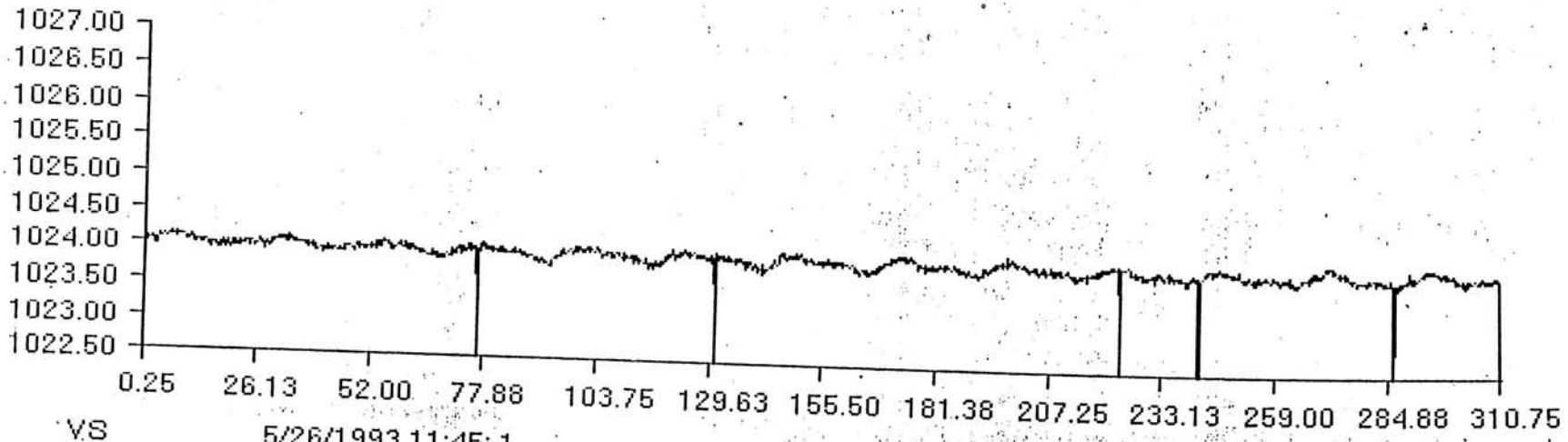
Interval = 1 hr
13 days
5/3/93



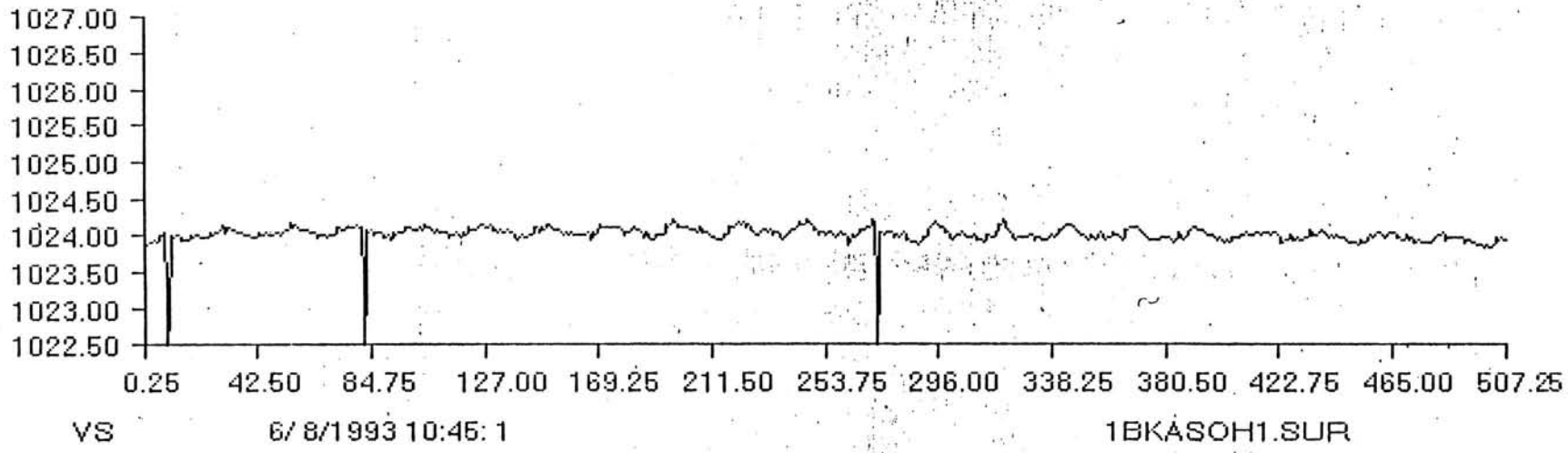
Interval = 15 min.
10 days
5/13/93
12:15



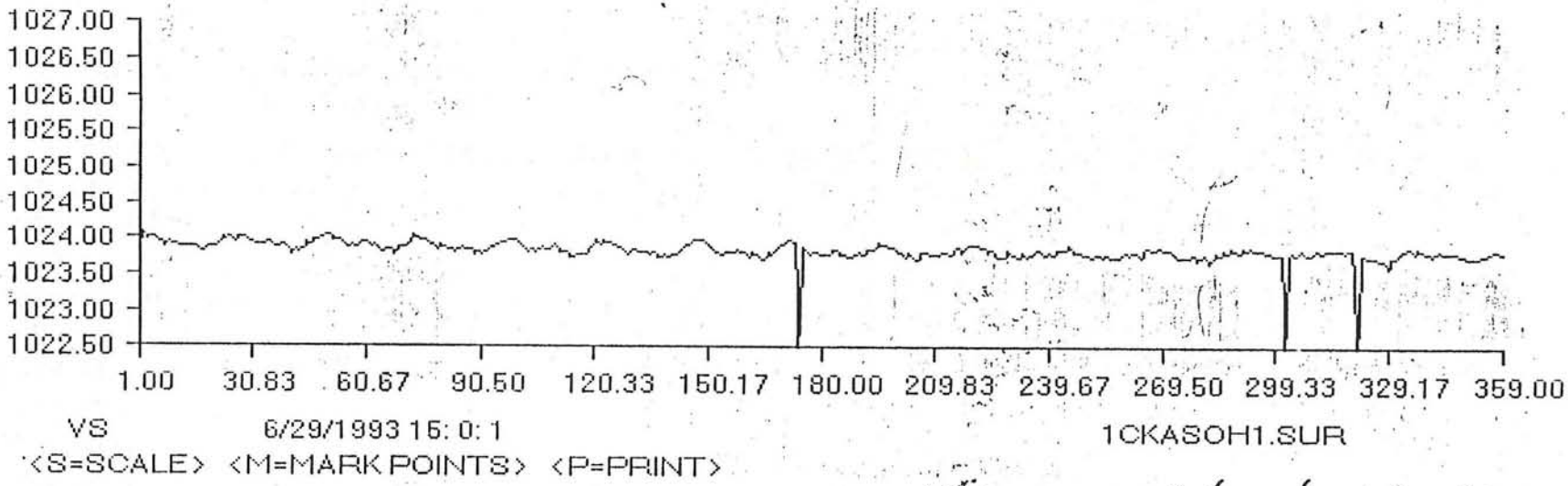
Interval = 15 min
13 days



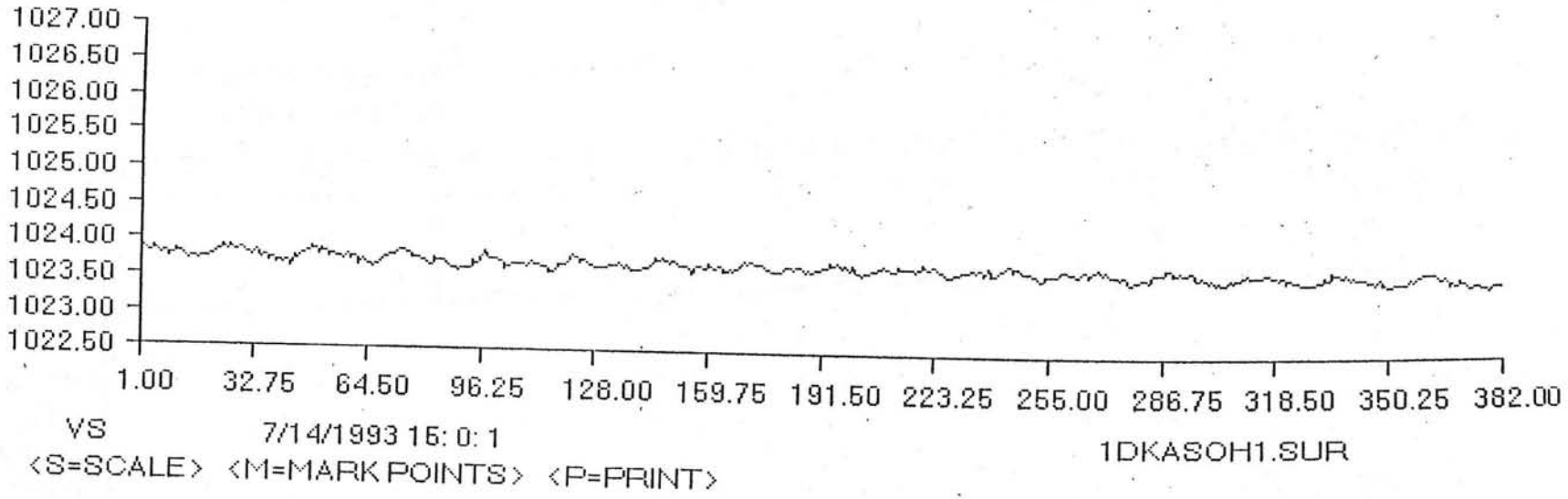
Interval = 15 min
13 days
6/8/93 10:45



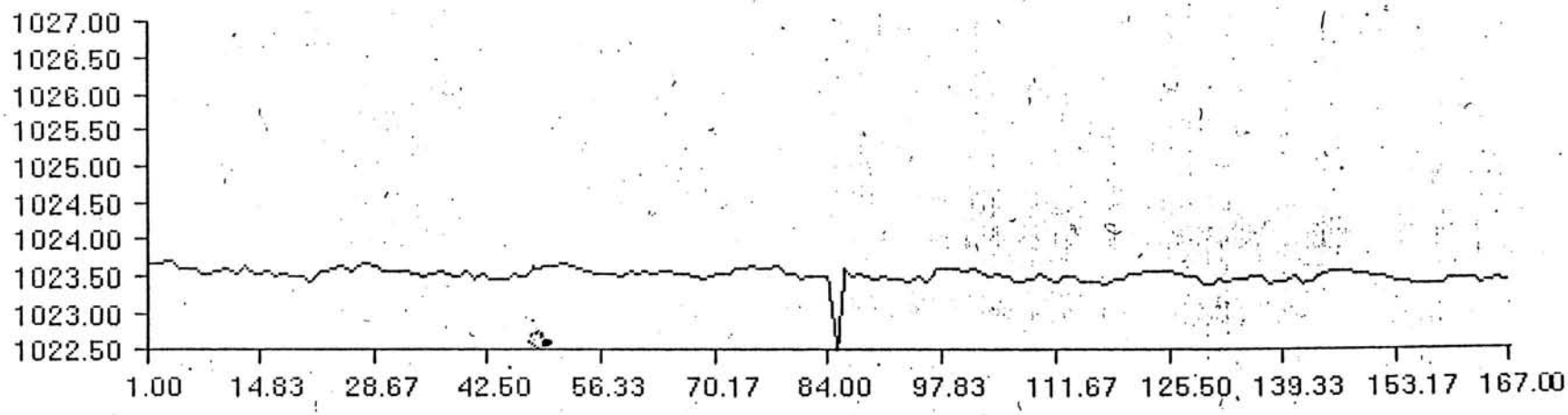
Interval = 1 hr
21 days
6/29/93 14:00



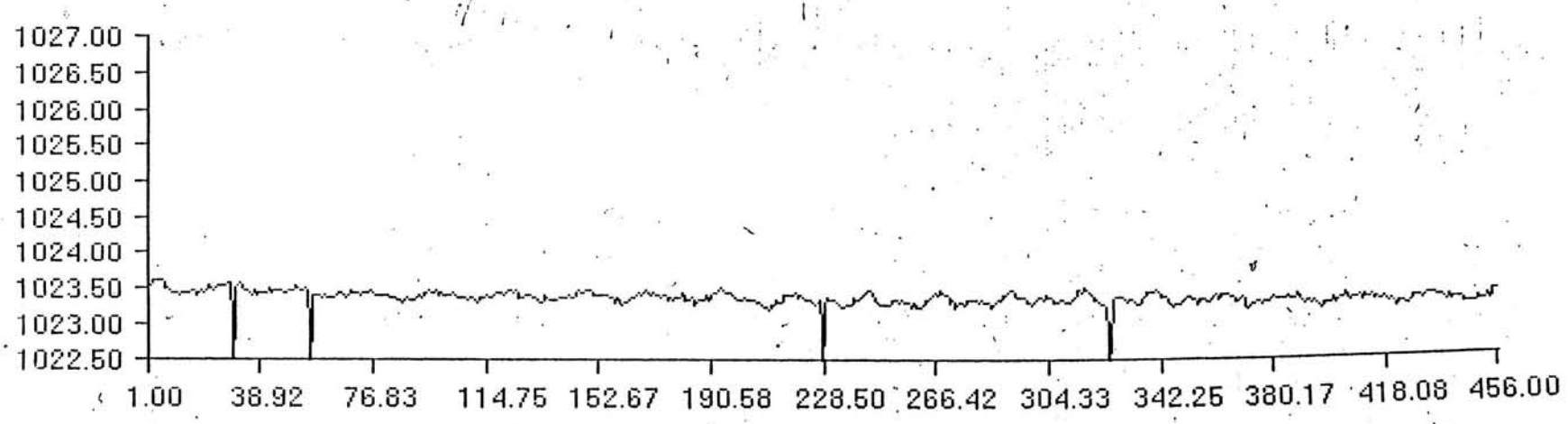
Interval = 1 hour
15 days
7/14/93 1414 hrs



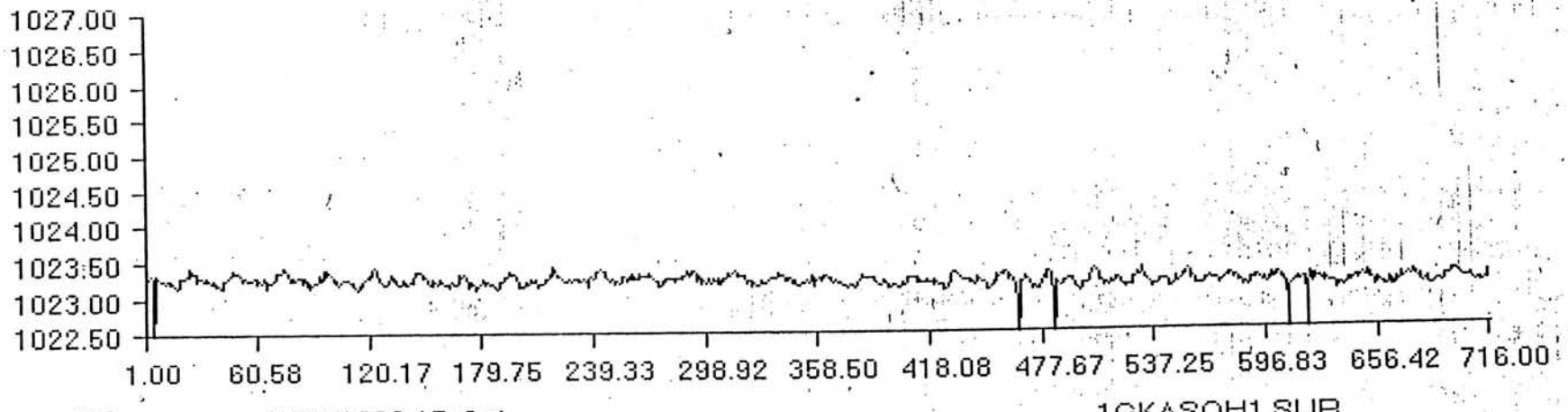
Interval = 1hr
16 days



Interval = 1 hr
8/6/93
7 days



Interval = 1 hr
19 days
8/25/93

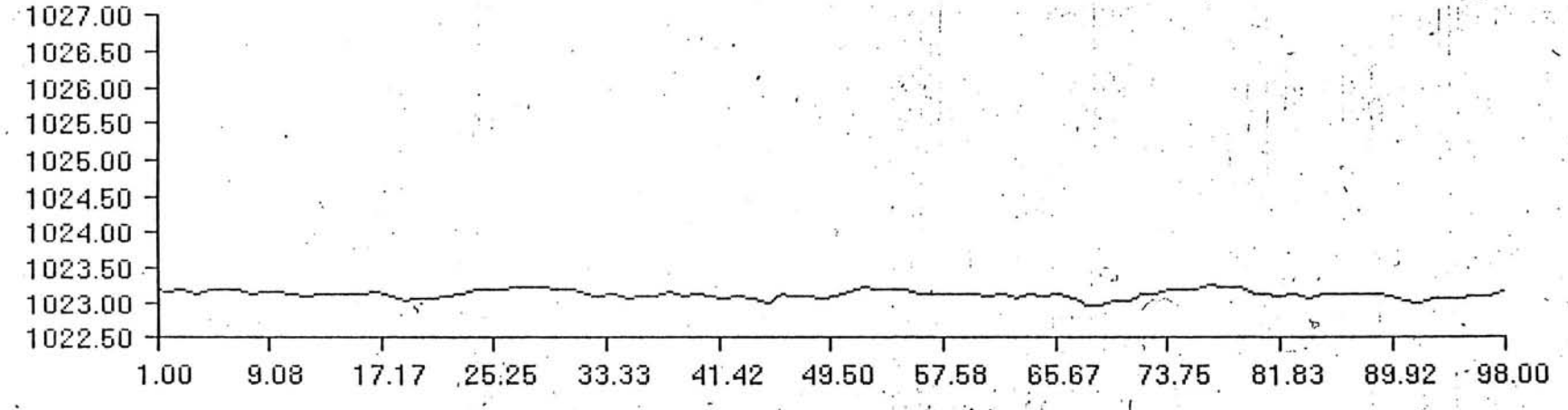


VS 8/25/1993 15: 0: 1

<S=SCALE> <M=MARK POINTS> <P=PRINT>

1GKASOH1.SUR

Interval = 1 hr
30 days
9/24/93 11:22

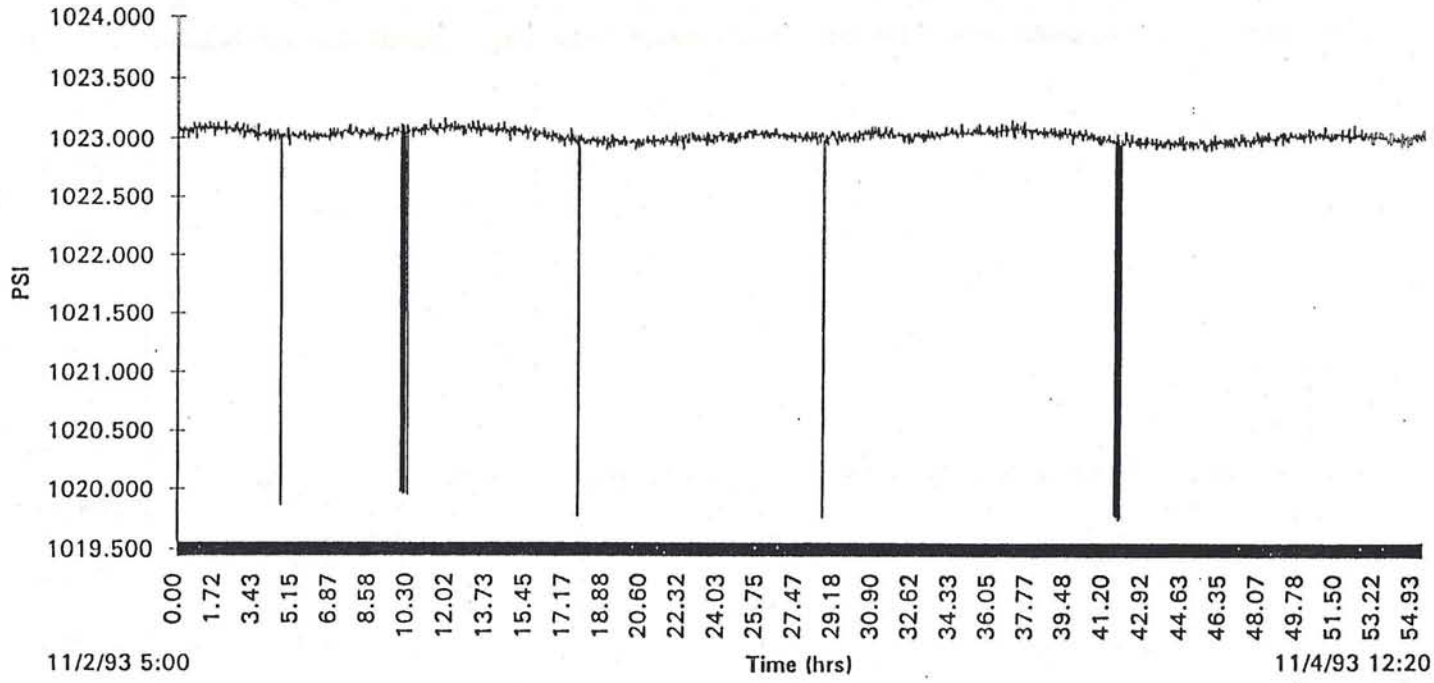


VS 9/24/1993 12: 0: 1

<S=SCALE> <M=MARK POINTS> <P=PRINT>

1HKASOH1.SUR

Interval = 1 hr
3 days
9/28/93 14:22


1024.000
1023.500
1023.000
1022.500
1022.000
1021.500
1021.000
1020.500
1020.000
1019.500
PSI
0.00
1.72
3.43
5.15
6.87
8.58
10.30
12.02
13.73
15.45
17.17
18.88
20.60
22.32
24.03
25.75
27.47
29.18
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34.33
36.05
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41.20
42.92
44.63
46.35
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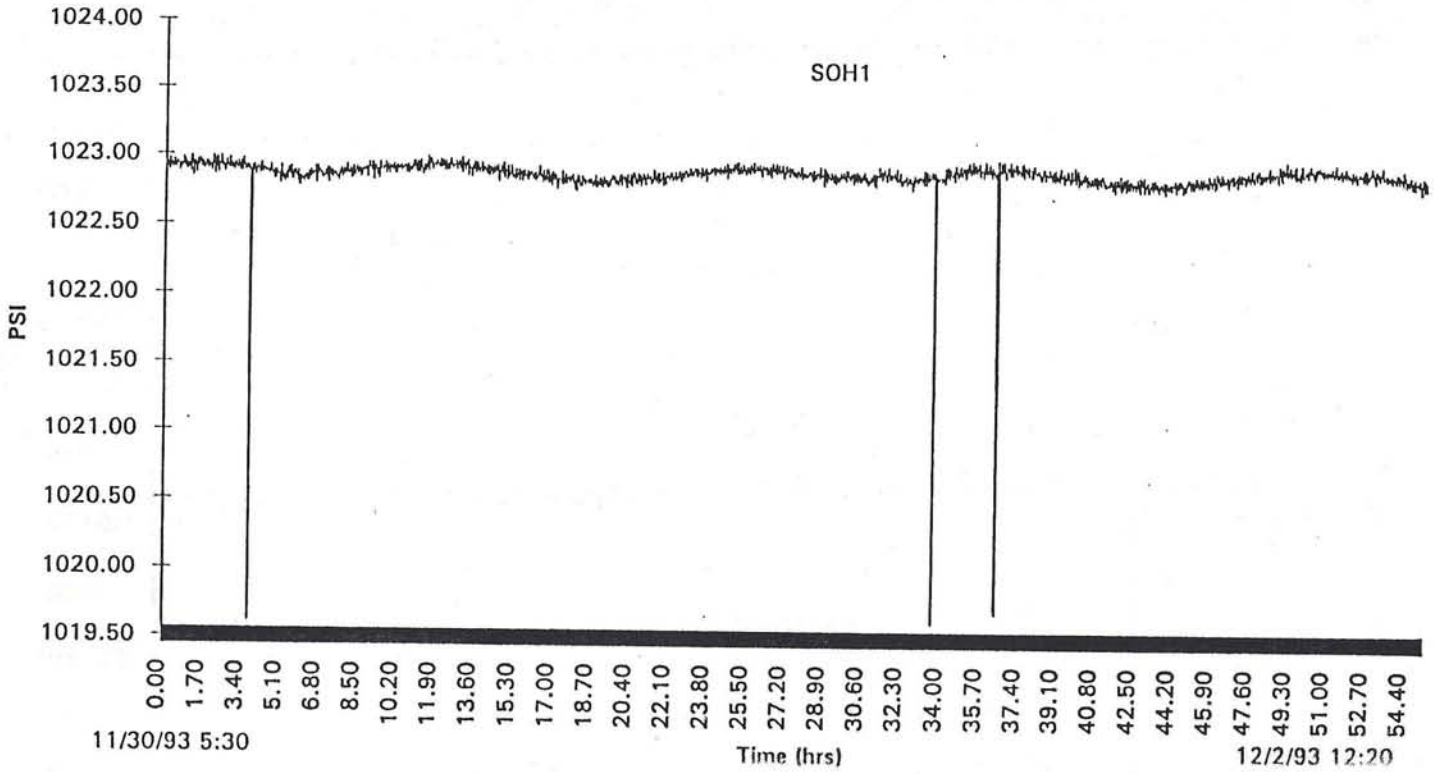
49.78
51.50
53.22
54.93
11/2/93 5:00
Time (hrs)
11/4/93 12:20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1022.50
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1021.50
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1020.00
1019.50
PSI
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1.70
3.40
5.10
6.80
8.50
10.20
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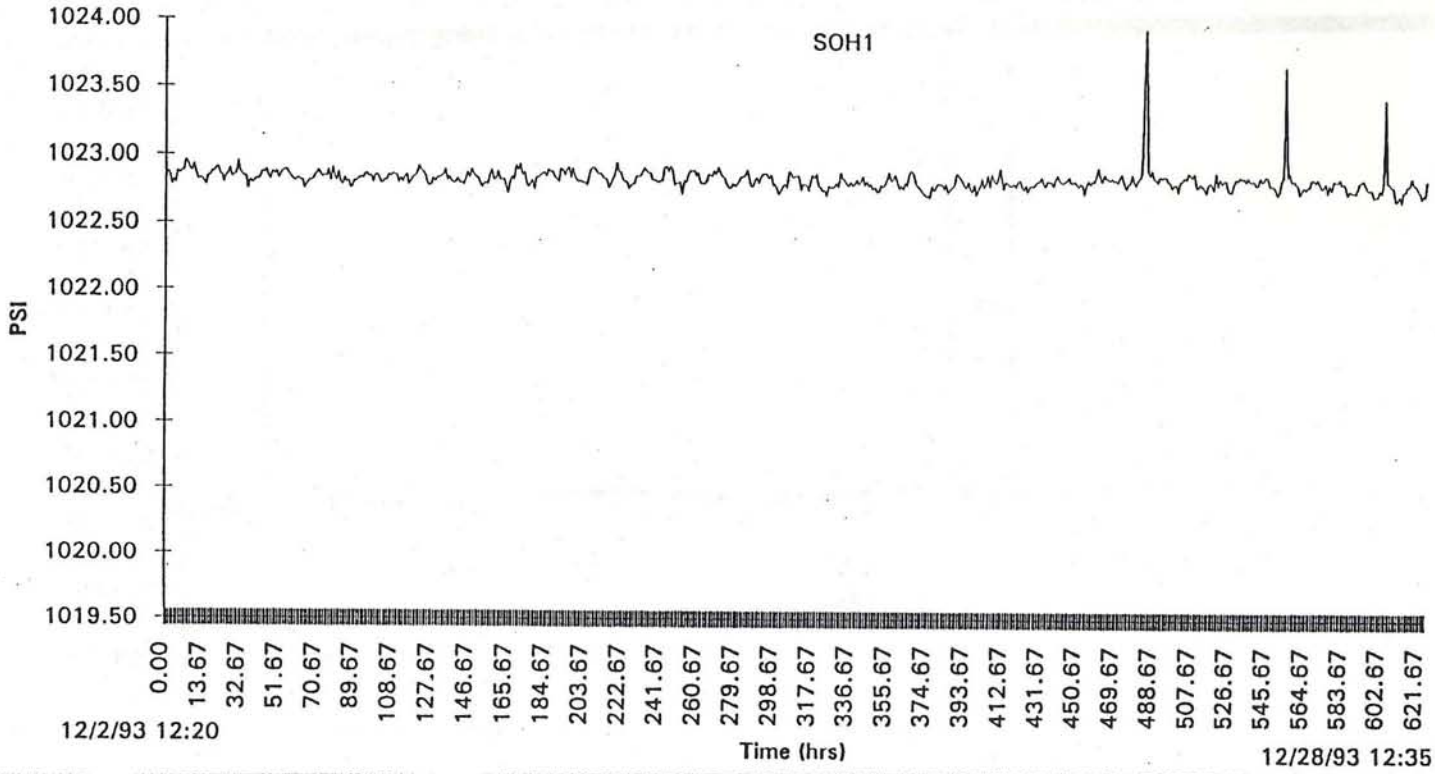
54.40
11/30/93 5:30
Time (hrs)
12/2/93 12:20


SOH1
PSI
1024.00
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1021.00
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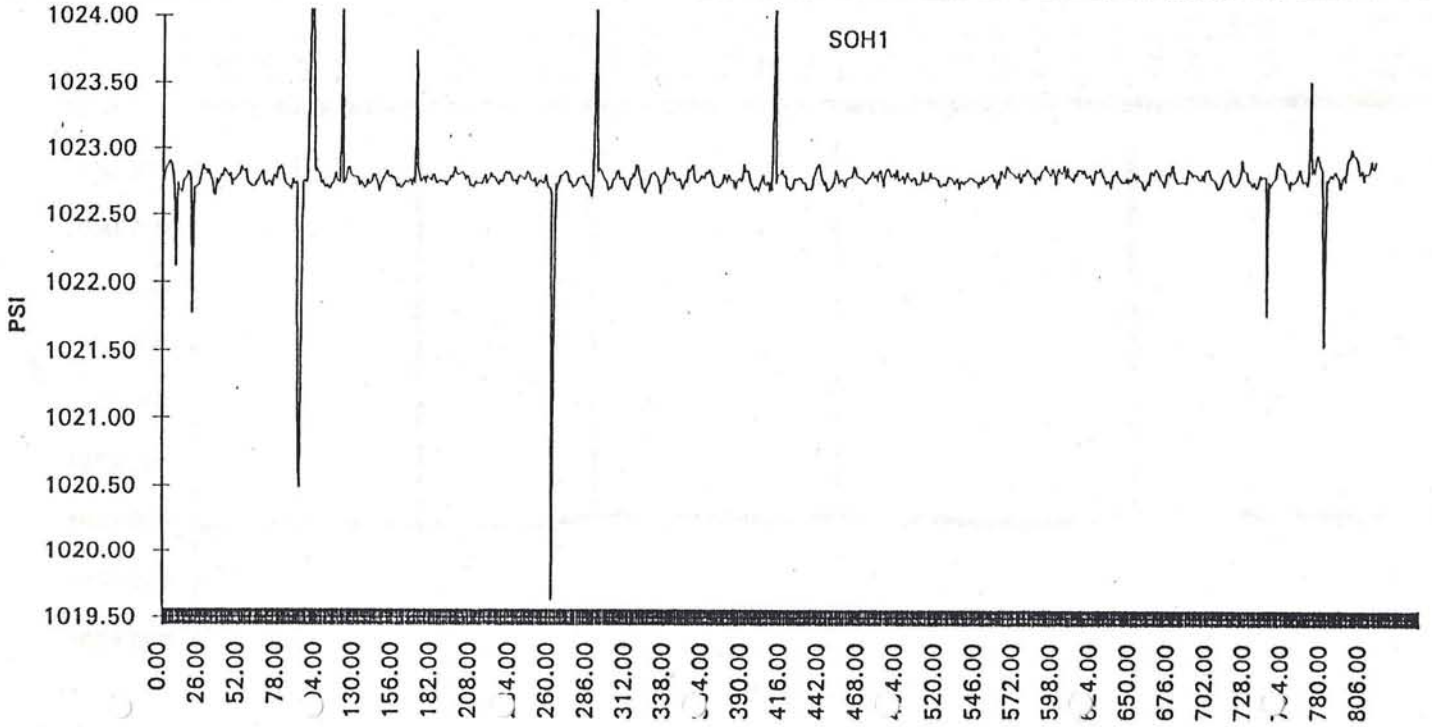
12/2/93 12:20
Time (hrs)
12/28/93 12:35


SOH1
PSI
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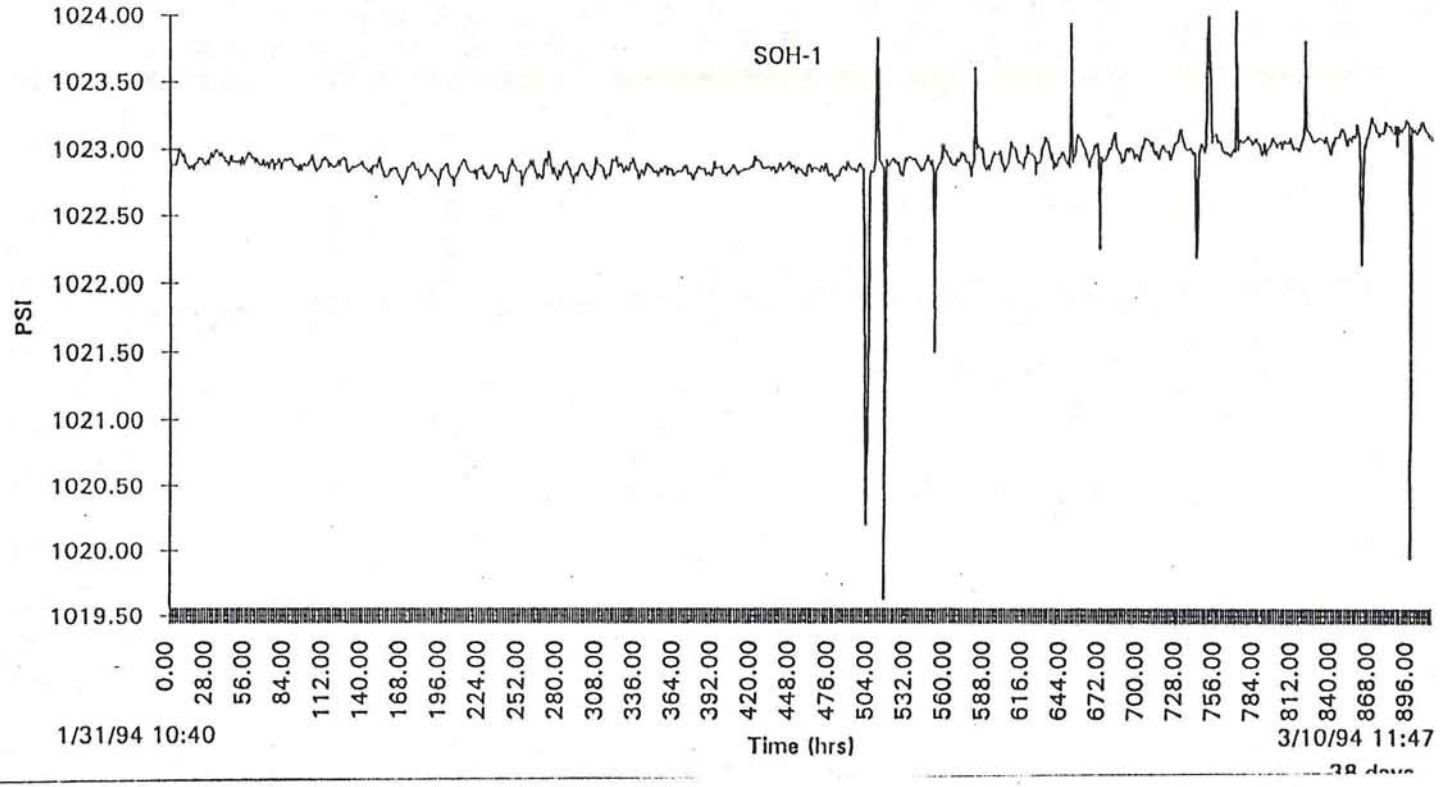
SOH-1
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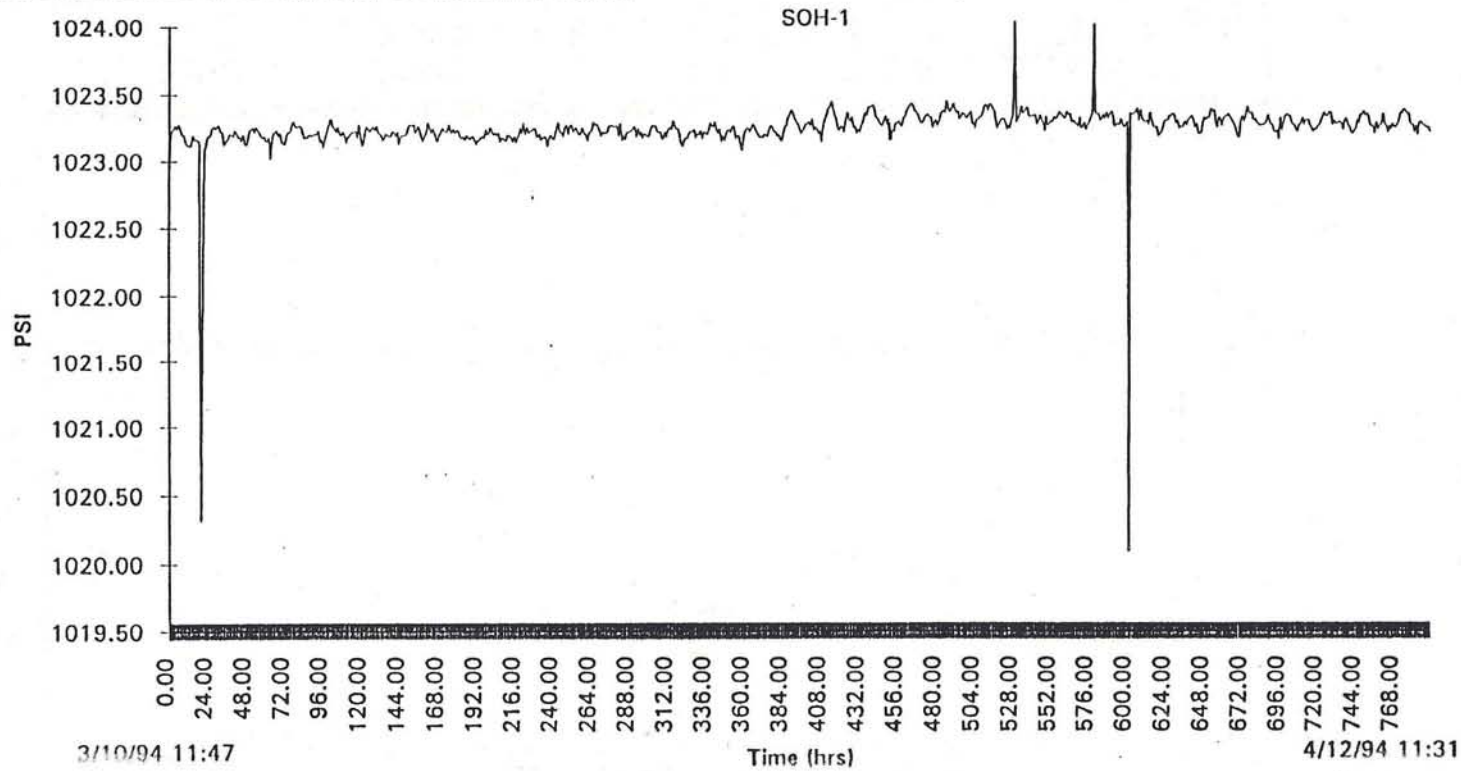
1/31/94 10:40
Time (hrs)
3/10/94 11:47


SOH-1
PSI
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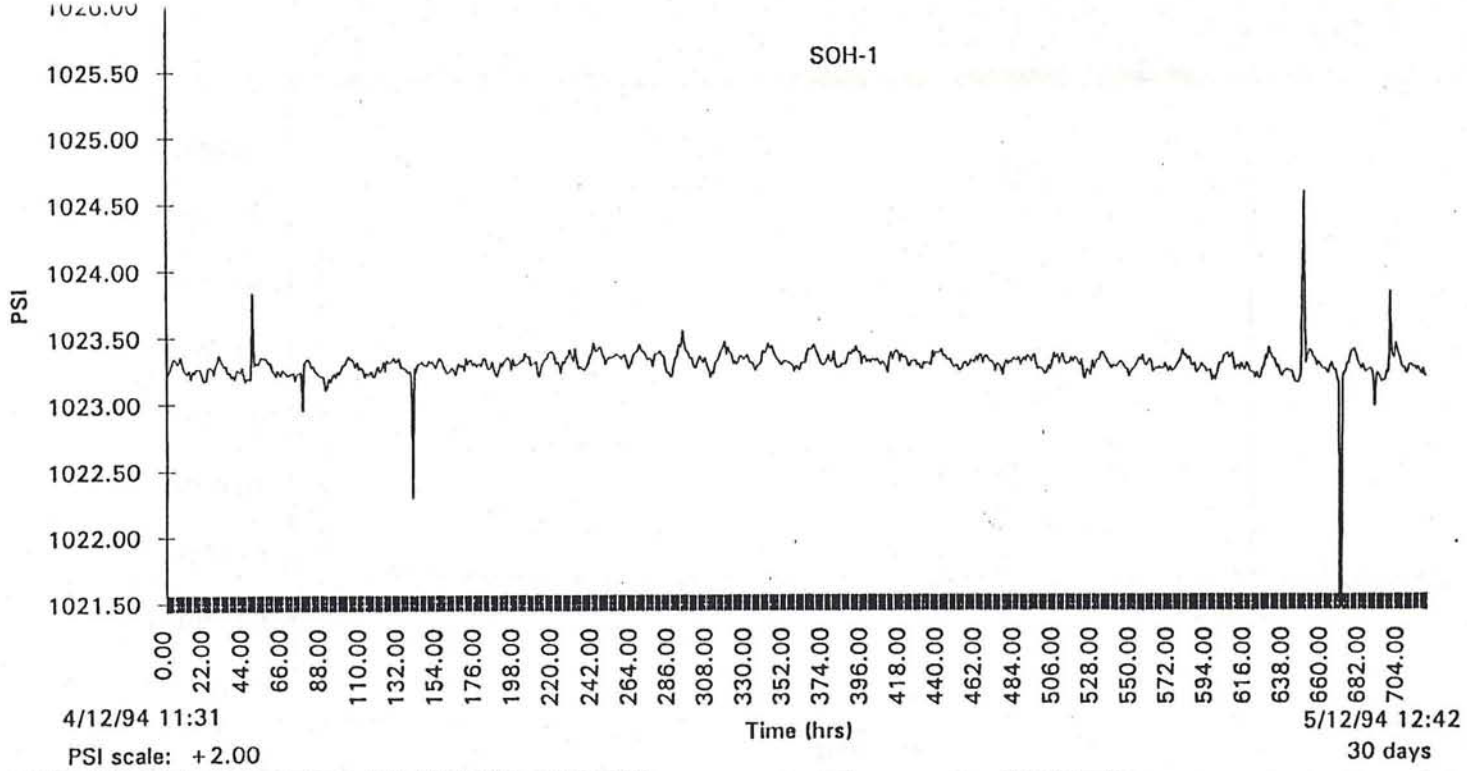
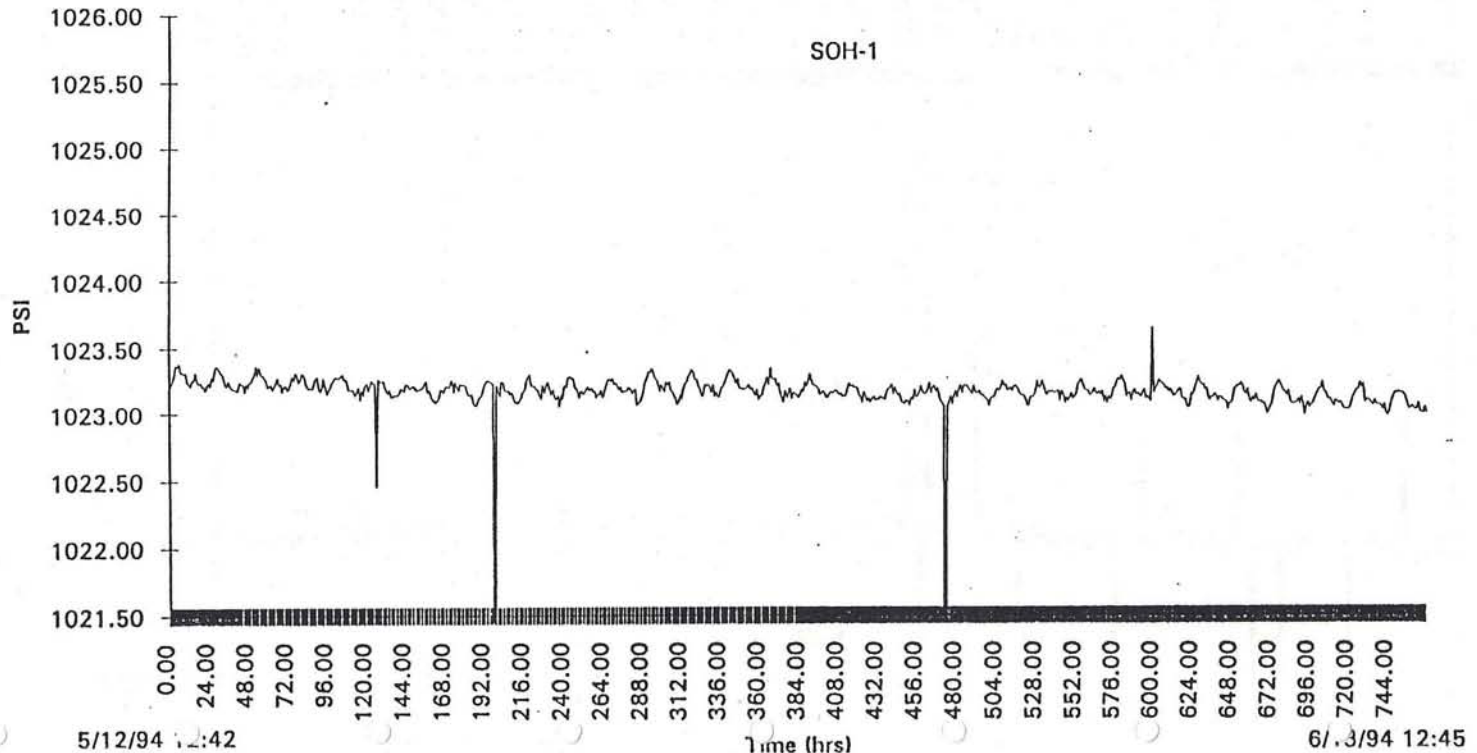
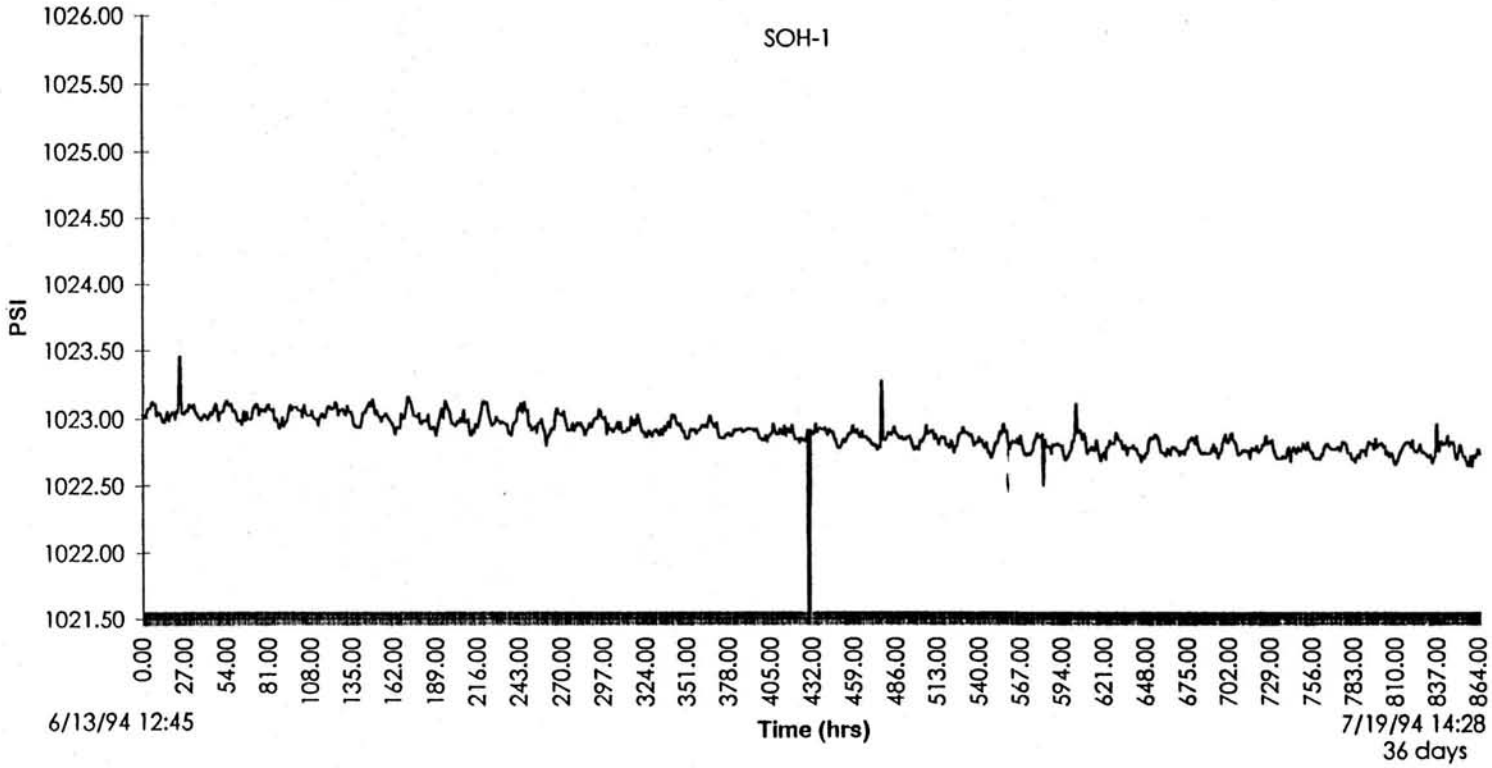
1023.00
1022.50
1022.00
1021.50
1021.00
1020.50
1020.00
1019.50
0.00
24.00
48.00
72.00
96.00
120.00
144.00
168.00
192.00
216.00
240.00
264.00
288.00
312.00
336.00
360.00
384.00
408.00
432.00
456.00
480.00
504.00
528.00
552.00
576.00
600.00
624.00
648.00
672.00
696.00
720.00
744.00
768.00
3/10/94 11:47
Time (hrs)
4/12/94 11:31

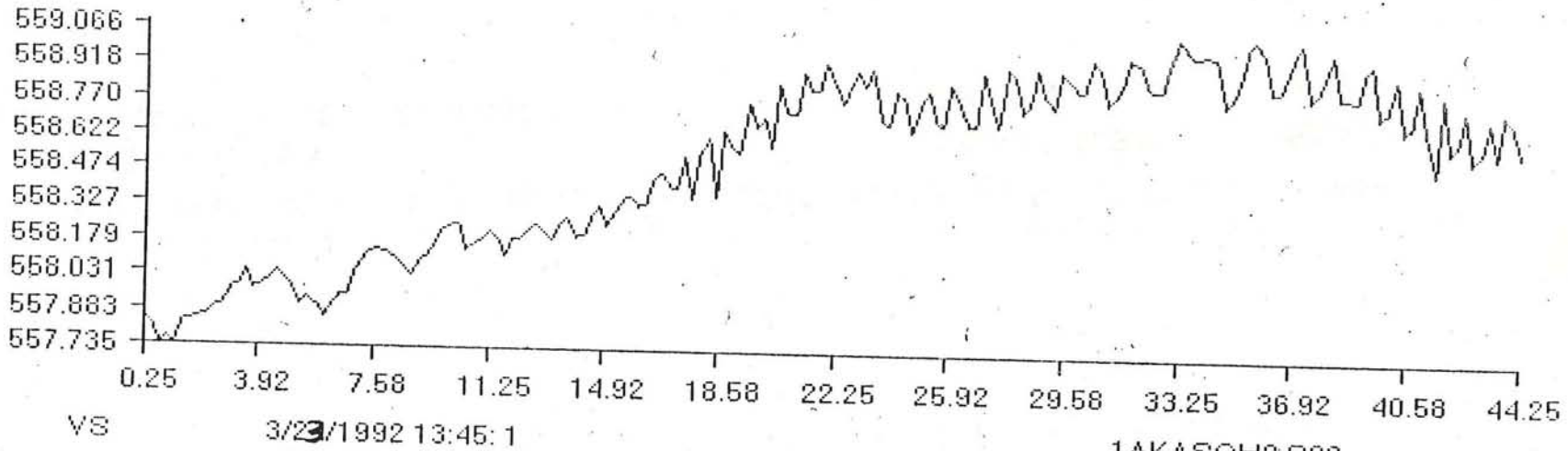

SOH-1
PSI
1025.50
1025.00
1024.50
1024.00
1023.50
1023.00
1022.50
1022.00
1021.50
0.00 22.00 44.00 66.00 88.00 110.00 132.00 154.00 176.00 198.00 220.00 242.00 264.00 286.00 308.00 330.00 352.00 374.00 396.00 418.00 440.00 462.00 484.00 506.00 528.00 550.00 572.00 594.00 616.00 638.00 660.00 682.00 704.00
4/12/94 11:31
Time (hrs)
5/12/94 12:42
PSI scale: +2.00
30 days


SOH-1
PSI
1026.00
1025.50
1025.00
1024.50
1024.00
1023.50
1023.00
1022.50
1022.00
1021.50
0.00 24.00 48.00 72.00 96.00 120.00 144.00 168.00 192.00 216.00 240.00 264.00 288.00 312.00 336.00 360.00 384.00 408.00 432.00 456.00 480.00 504.00 528.00 552.00 576.00 600.00 624.00 648.00 672.00 696.00 720.00 744.00
5/12/94 12:42
Time (hrs)
6/13/94 12:45


SOH-1
PSI
1026.00
1025.50
1025.00
1024.50
1024.00
1023.50
1023.00
1022.50
1022.00
1021.50
0.00
27.00
54.00
81.00
108.00
135.00
162.00
189.00
216.00
243.00
270.00
297.00
324.00
351.00
378.00
405.00
432.00
459.00
486.00
513.00
540.00
567.00
594.00
621.00
648.00
675.00
702.00
729.00
756.00
783.00
810.00
837.00
864.00
6/13/94 12:45
Time (hrs)
7/19/94 14:28
36 days

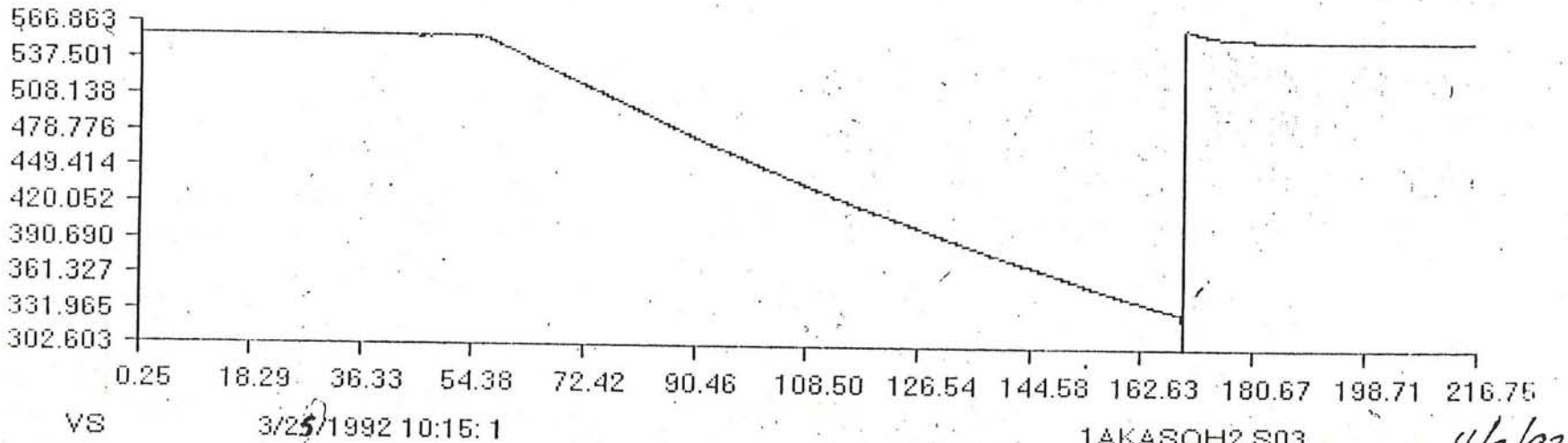
APPENDIX II

Graph of SOH-2 Pressure Data



1AKASOH2.S02
Datalog . c4
I = 15m

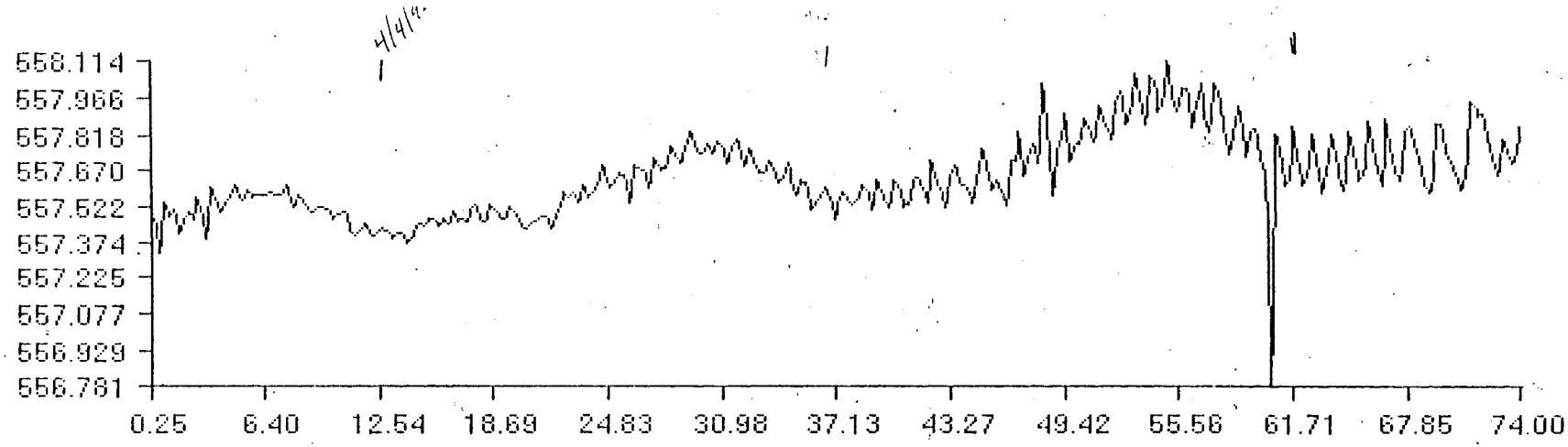
3/25/92

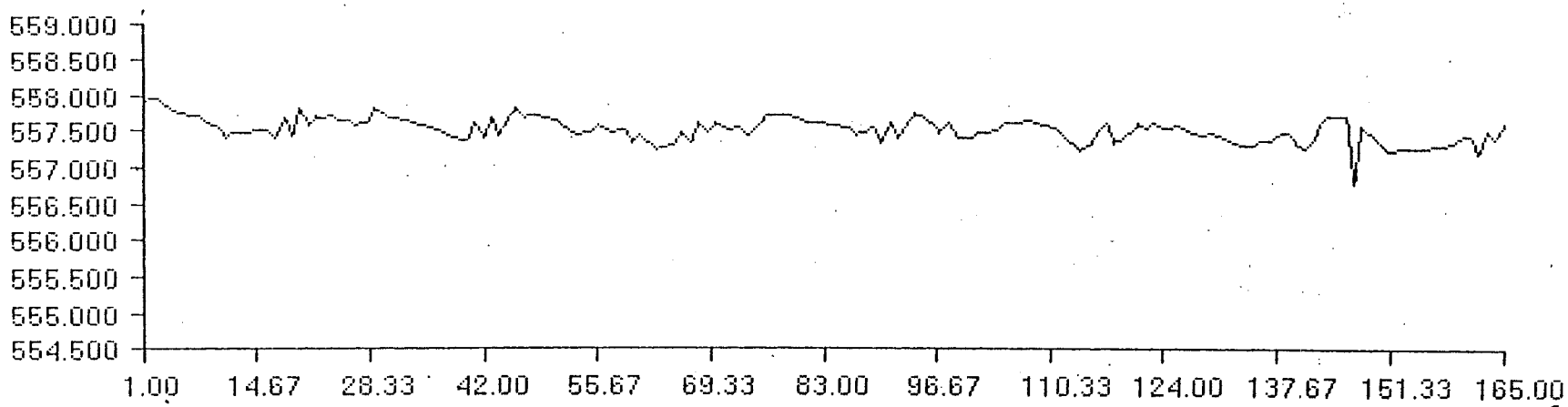


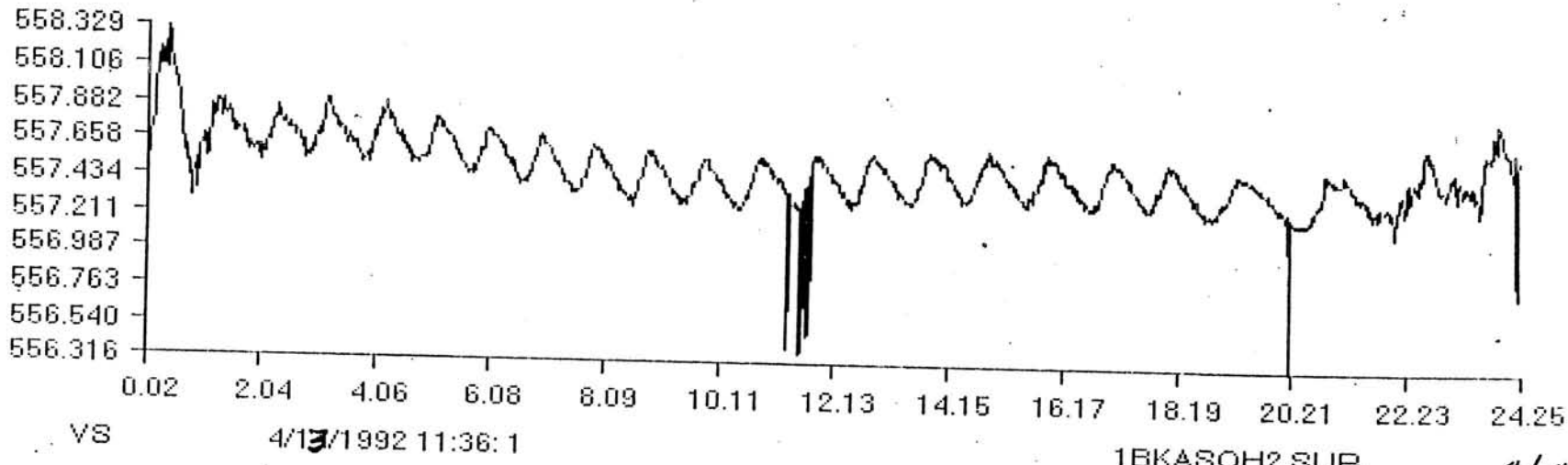
1AKASOH2.S03

4/3/92

Datalog. C5
Interval = 15 min
> 4/1/92 (~[illegible] hrs)
purge, fix leak (13.00 hrs)
no communication w/datalogger


4/4/92
558.114
557.966
557.818
557.670
557.522
557.374
557.225
557.077
556.929
556.781
0.25
6.40
12.54
18.69
24.83
30.98
37.13
43.27
49.42
55.56
61.71
67.85
74.00
VS
4/3/1992 11:15: 1
1AKASOH2.S04
Datalog.C6
Interval = 15min
4/6/92
13:15

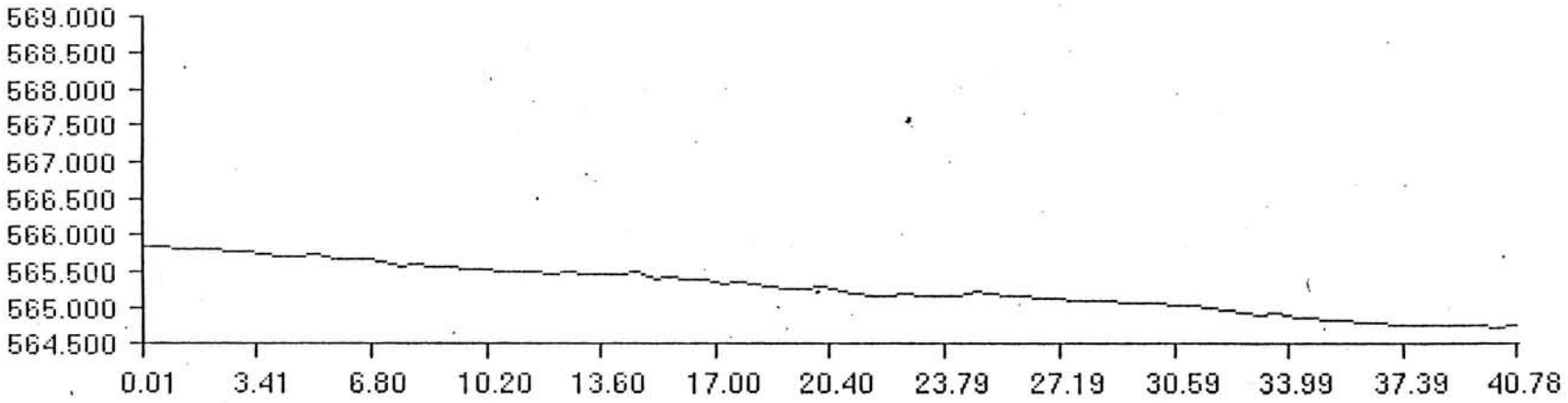

559.000
558.500
558.000
557.500
557.000
556.500
556.000
555.500
555.000
554.500
1.00
14.67
28.33
42.00
55.67
69.33
83.00
96.67
110.33
124.00
137.67
151.33
165.00
VS
4/6/1992 14: 0: 1
1AKASOH2.S05
INTERVAL = 1 HR
4/13/92
11:28
<S=SCALE> <M=MARK POINTS> <P=PRINT>



1BKASOH2.SUR

4/14/92
11:50

Datalog. DI (huge)
Interval = 1 min.
Breakdown in communication w/ datalogger unable to ΔI or download 4/30 shut off. This file saved (huge)
Datalogger sent to Pruett w/ gel cell for repair

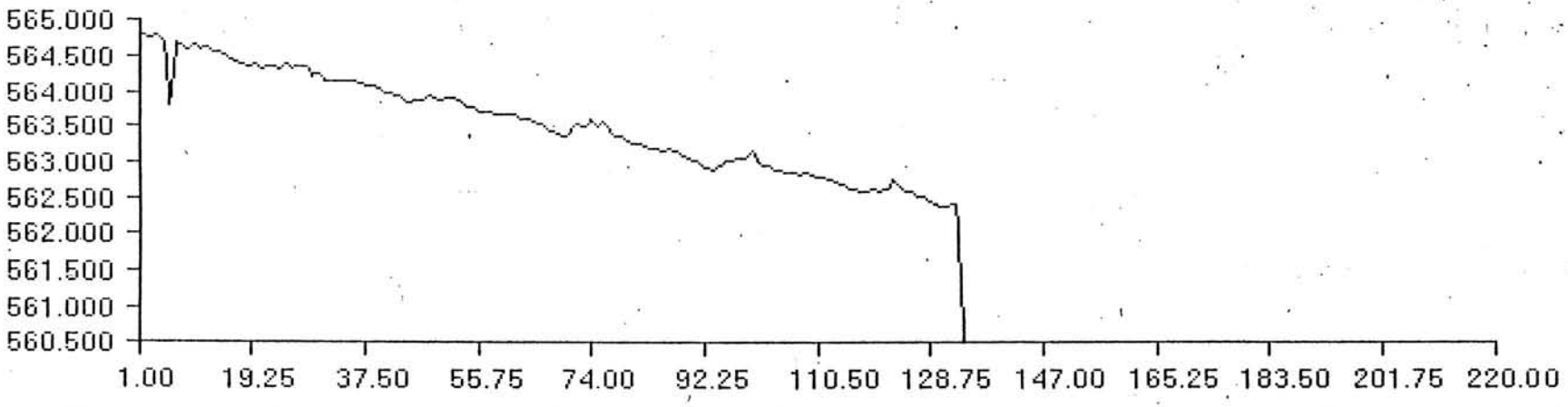


1BKASOH2.S01

5/6/92

INTERVAL = 30 MIN

Reinstall Datalogger following repair work



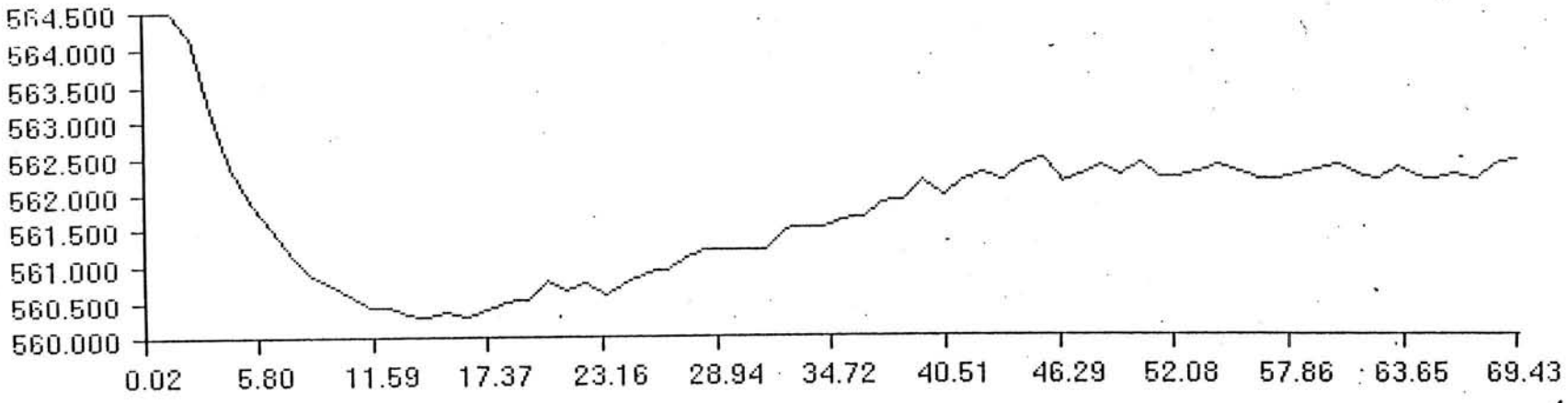
VS 5/ 6/1992 9: 0: 1 1BKASOH2.S02

<S=SCALE> <M=MARK POINTS> <P=PRINT>

INTERVAL = 1 HR

5/15/92 13:05

SAMPLE FITTING



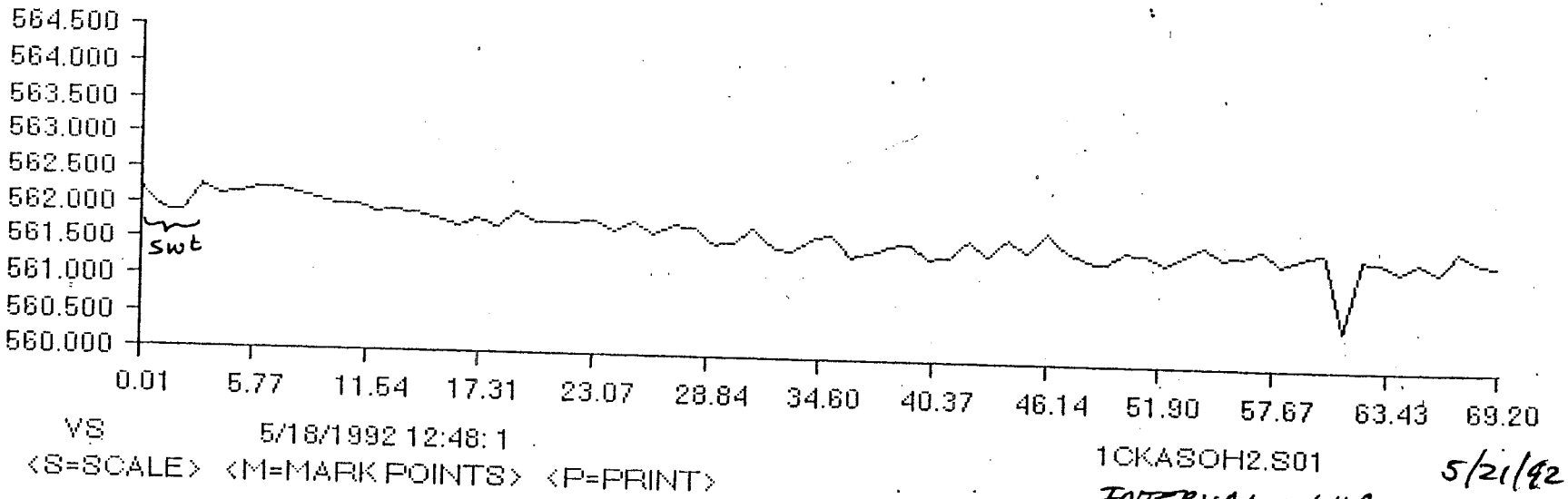
VS 5/15/1992 14:34: 1 1CKASOH2.SUR.

<S=SCALE> <M=MARK POINTS> <P=PRINT>

INTERVAL = 1 HR

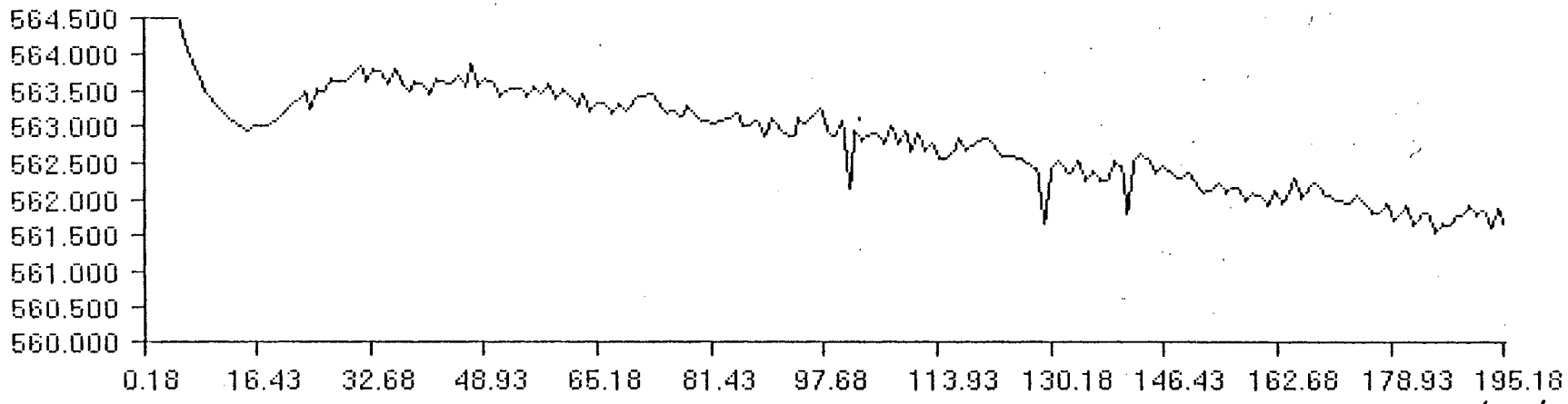
5/18/92

5/15/92
PURGED



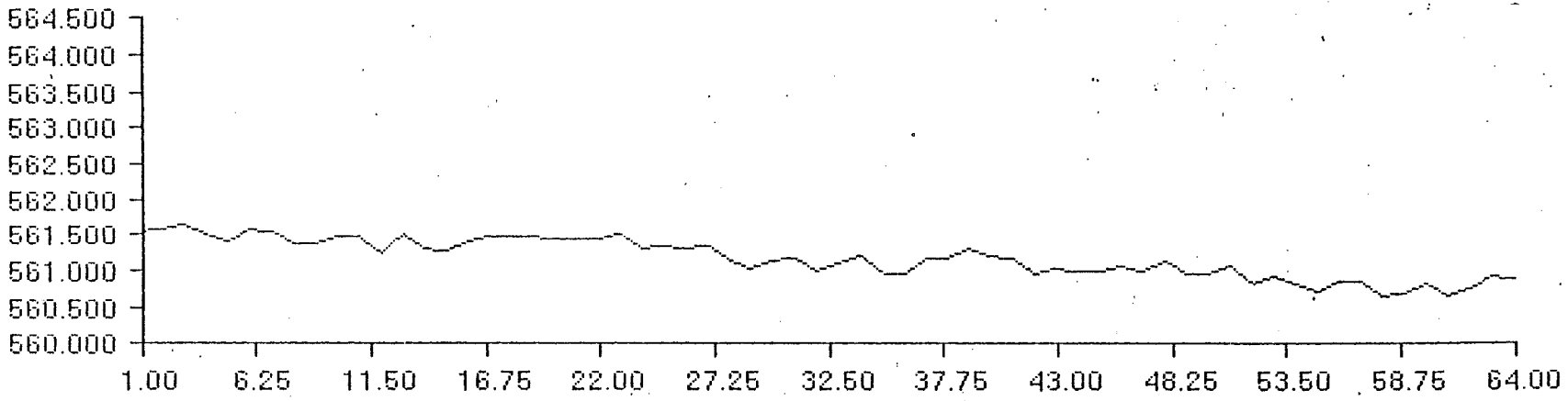
5/21/92

5/18/92
Surface whip test



5/29/92

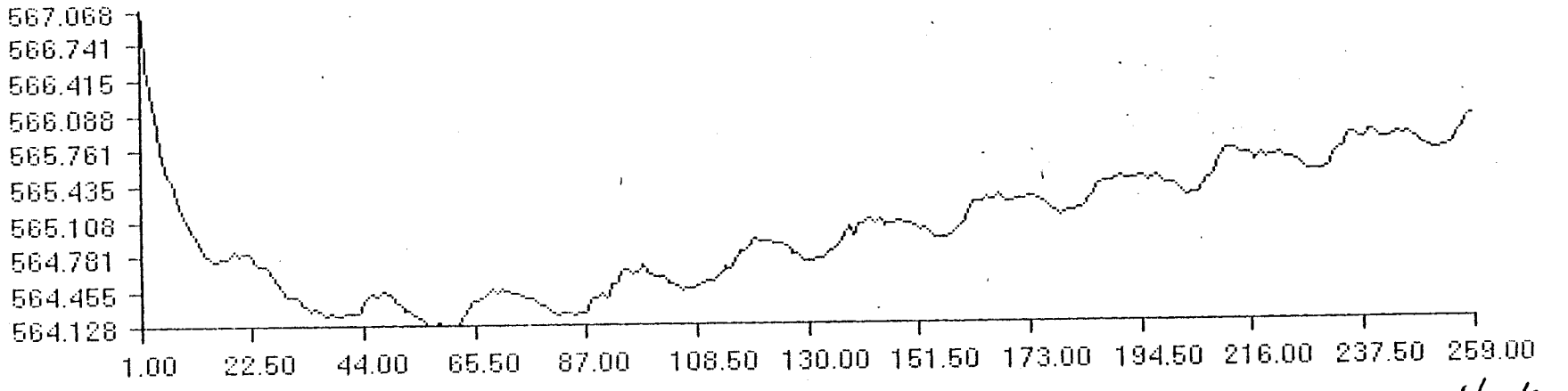
5/21/92
PURGED



VS 5/29/1992 17: 0: 1 1DKASOH2.SUR 6/1/92

<S=SCALE> <M=MARK POINTS> <P=PRINT>

INTERVAL = 1HR



VS 6/12/1992 16: 0: 1 1DKASOH2.S00 6/23/92

purged

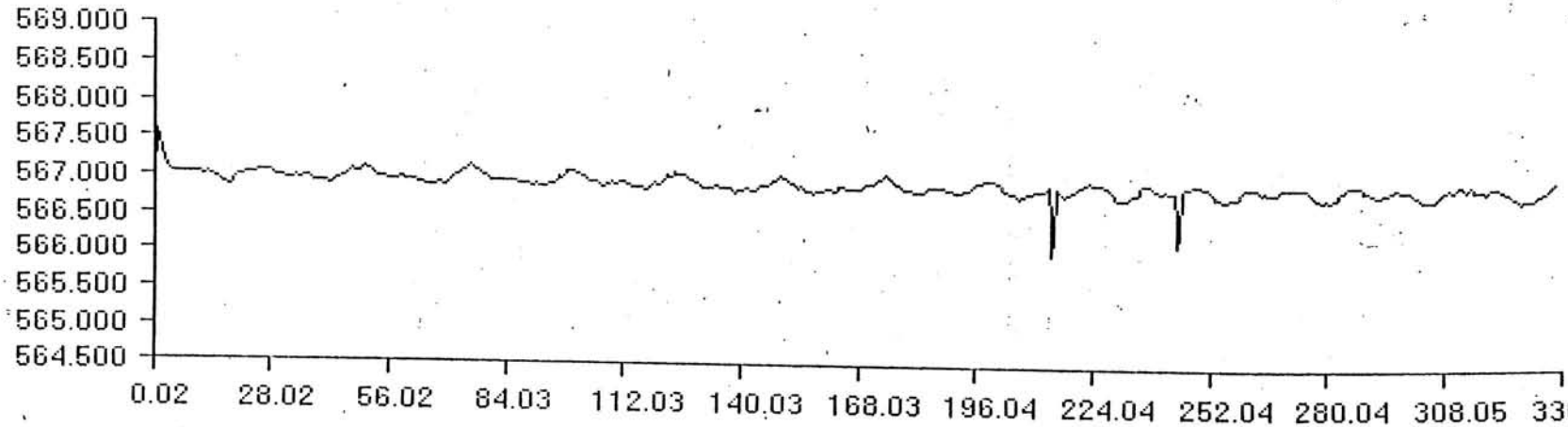
Datalog. D 19

Interval = 1 hr.

6/4 roof up

6/1 - 6/12 no data

6/10 - 6/12 E. Pruett testing/adjusting eqp.



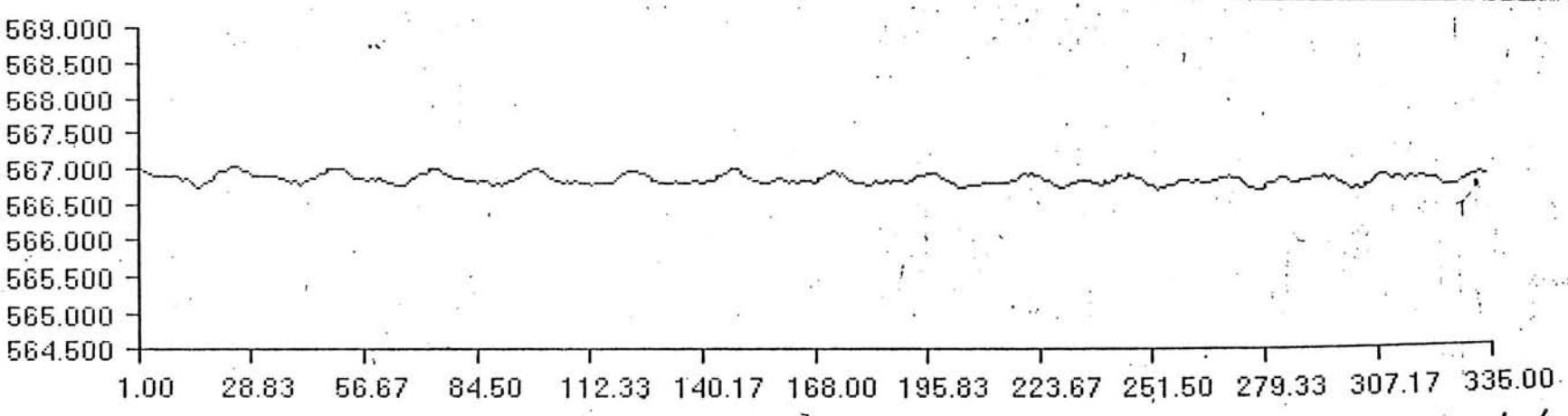
VS 6/23/1992 11:57: 1

<S=SCALE> <M=MARK POINTS> <P=PRINT>

6/23/92
purged

a:1EKASOH2.SUR 7/7/92

Interval = 1m. 12:20

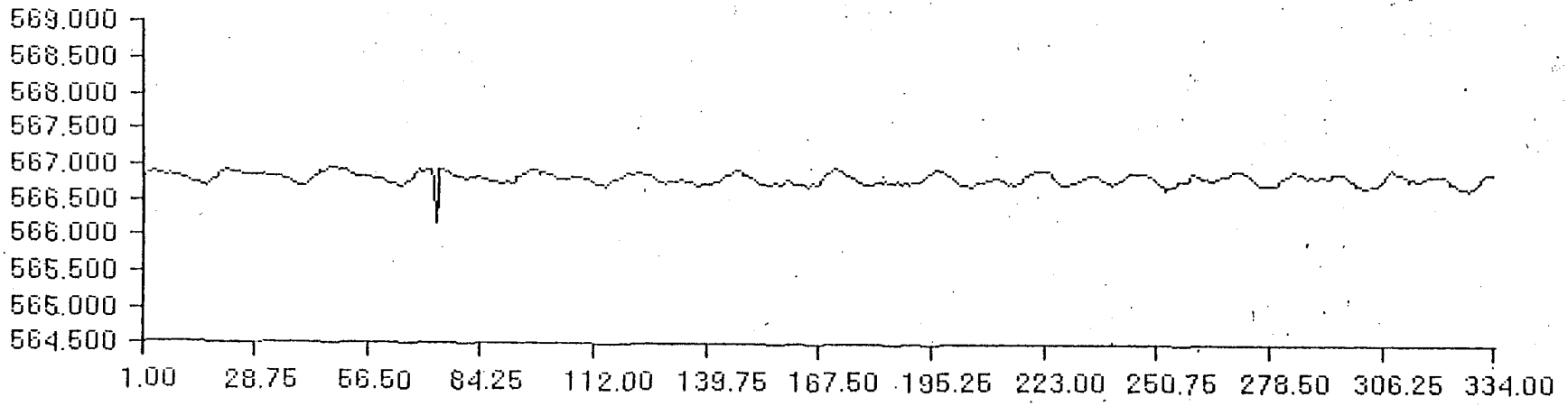


VS 7/ 7/1992 13: 0: 1

<S=SCALE> <M=MARK POINTS> <P=PRINT>

a:1FKASOH2.SUR 7/21/92

Interval = 1hr 12:09

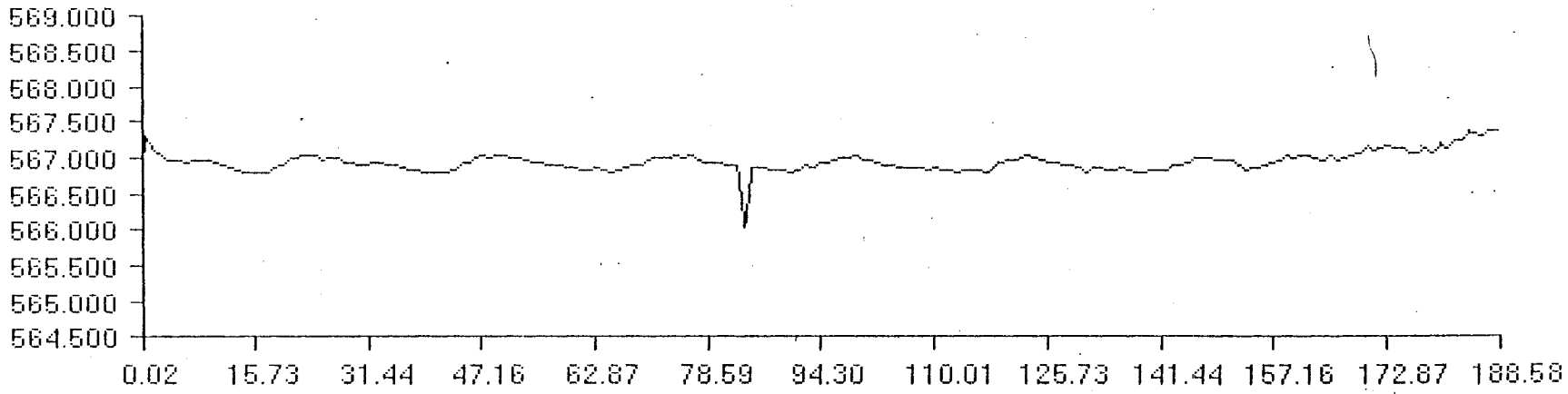


VS 7/21/1992 13: 0: 1 1GKASOH2.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

I = 1hr

8/4/92
12:00
purge



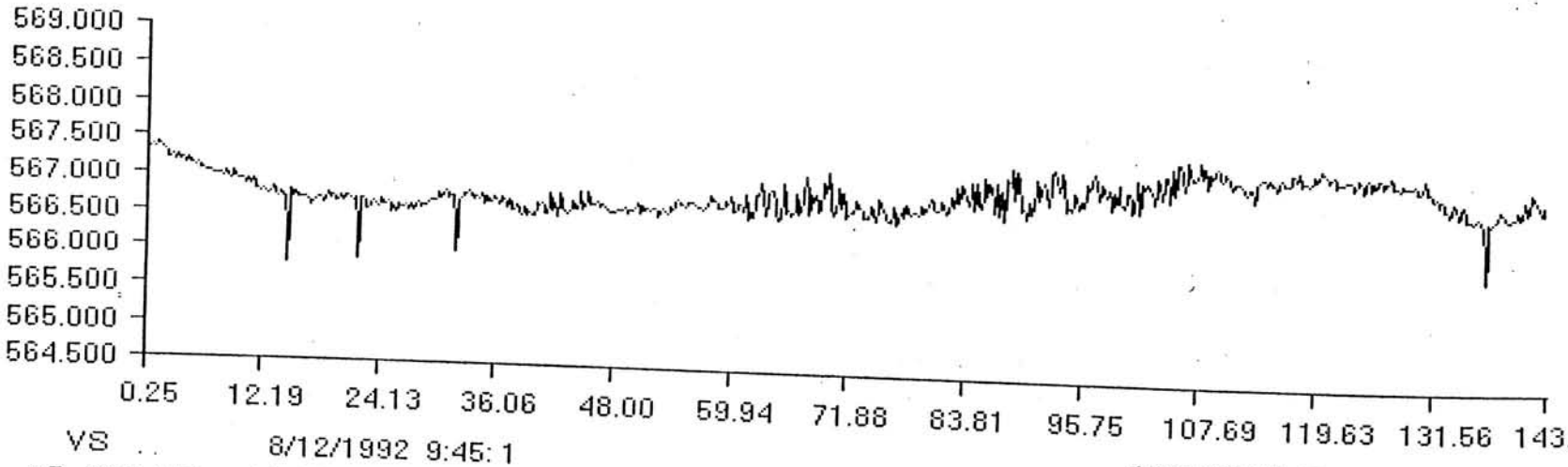
VS 8/ 4/1992 12:25: 1 1HKASOH2.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

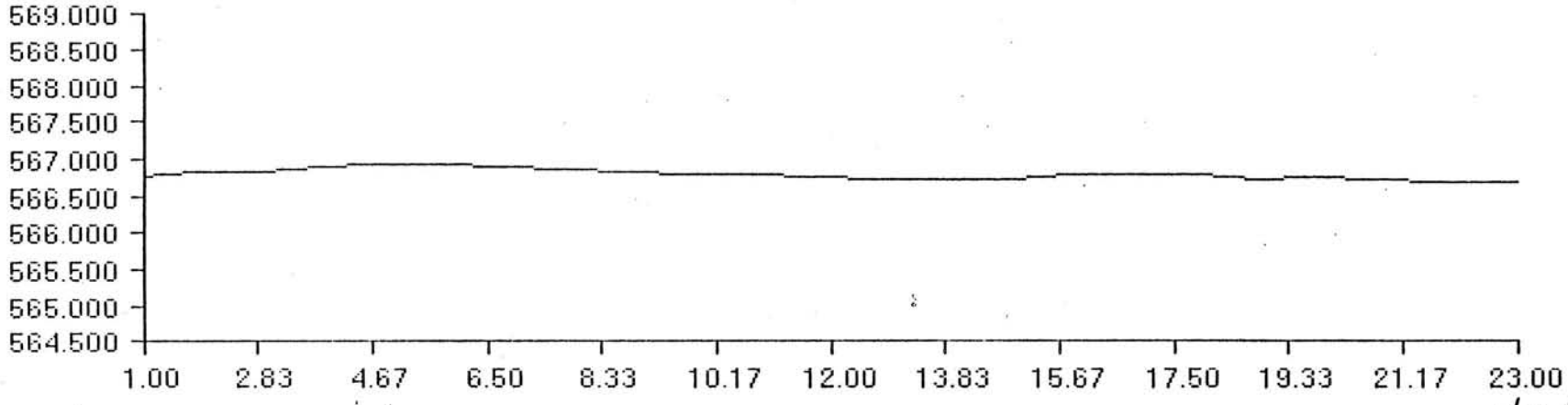
INTERVAL = 1HR

8/12/92
9:30

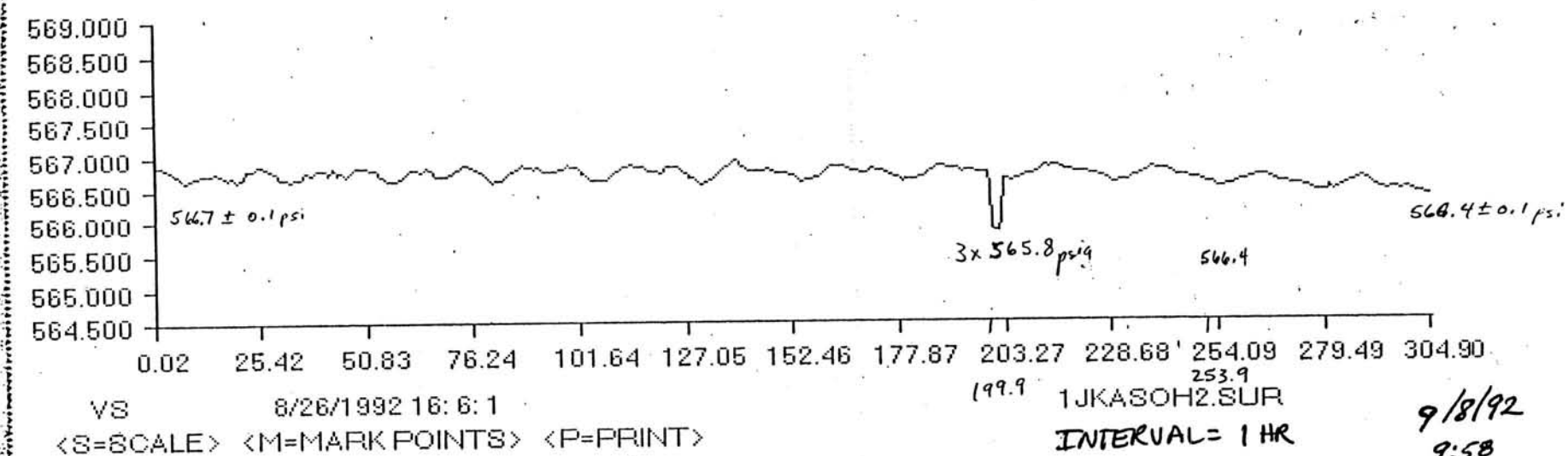
8/4/92 PURGE

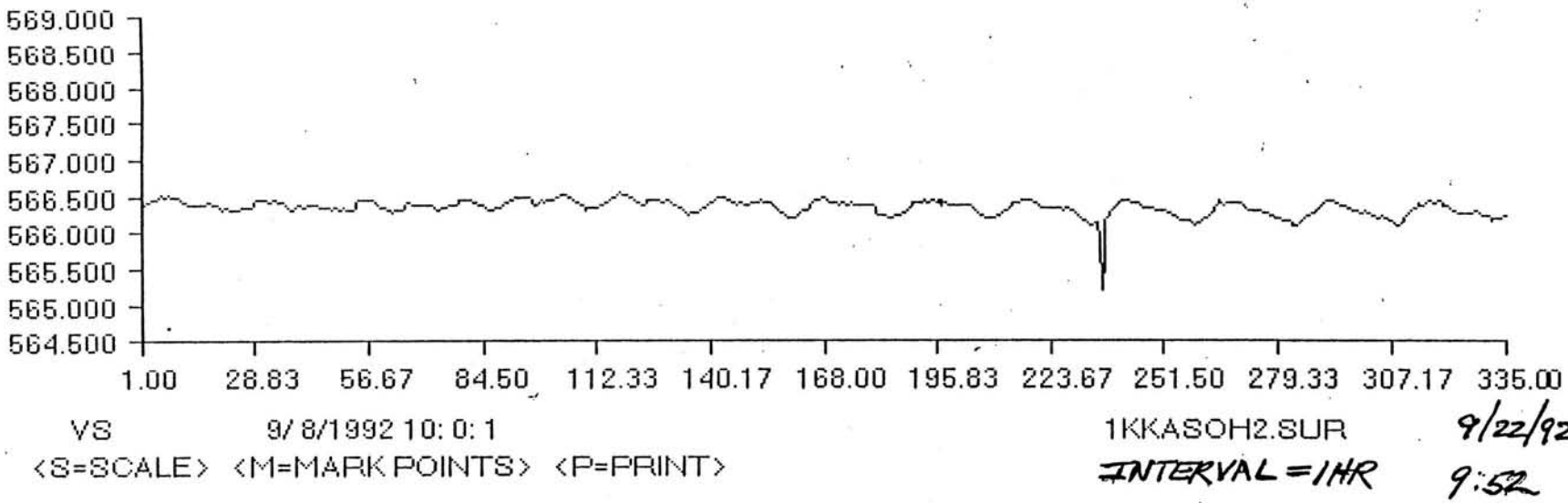


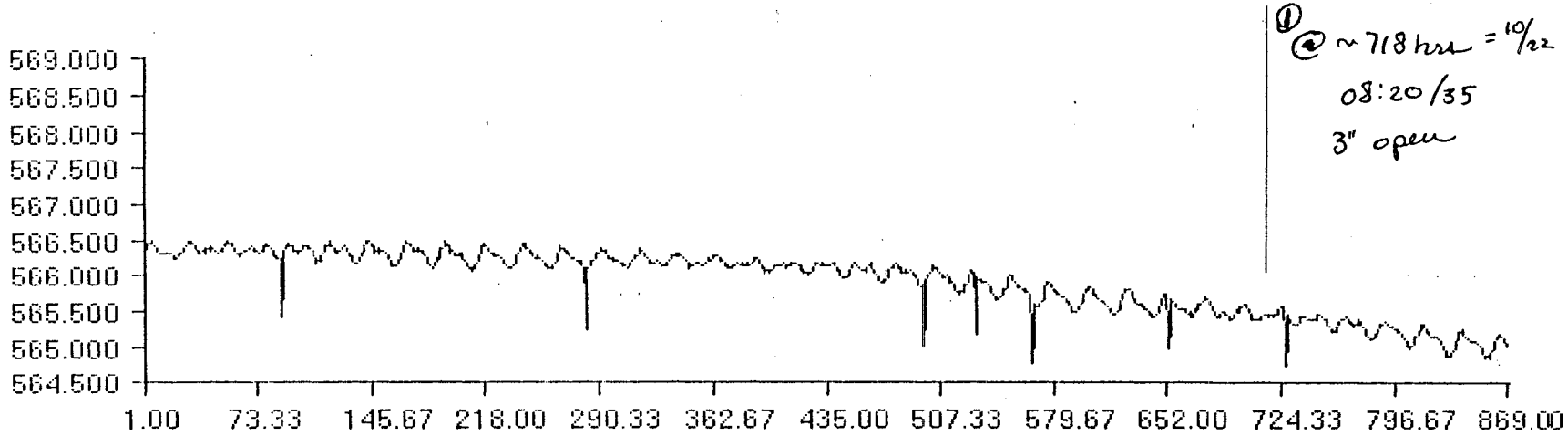
2



Electronic failure
loss of data 8/18 – 8/25/92


569.000
568.500
568.000
567.500
567.000
566.500
566.000
565.500
565.000
564.500
567.7 ± 0.1 psi
3x 565.8 psig
566.4
568.4 ± 0.1 psi
0.02
25.42
50.83
76.24
101.64
127.05
152.46
177.87
203.27
228.68
254.09
279.49
304.90
199.9
253.9
VS 8/26/1992 16: 6: 1
1JKASOH2.SUR
<S=SCALE> <M=MARK POINTS> <P=PRINT>
INTERVAL= 1 HR
9/8/92
9:58


569.000
568.500
568.000
567.500
567.000
566.500
566.000
565.500
565.000
564.500
1.00
28.83
56.67
84.50
112.33
140.17
168.00
195.83
223.67
251.50
279.33
307.17
335.00
VS 9/ 8/1992 10: 0: 1
1KKASOH2.SUR
<S=SCALE> <M=MARK POINTS> <P=PRINT>
INTERVAL = 1HR
9/22/92
9:52

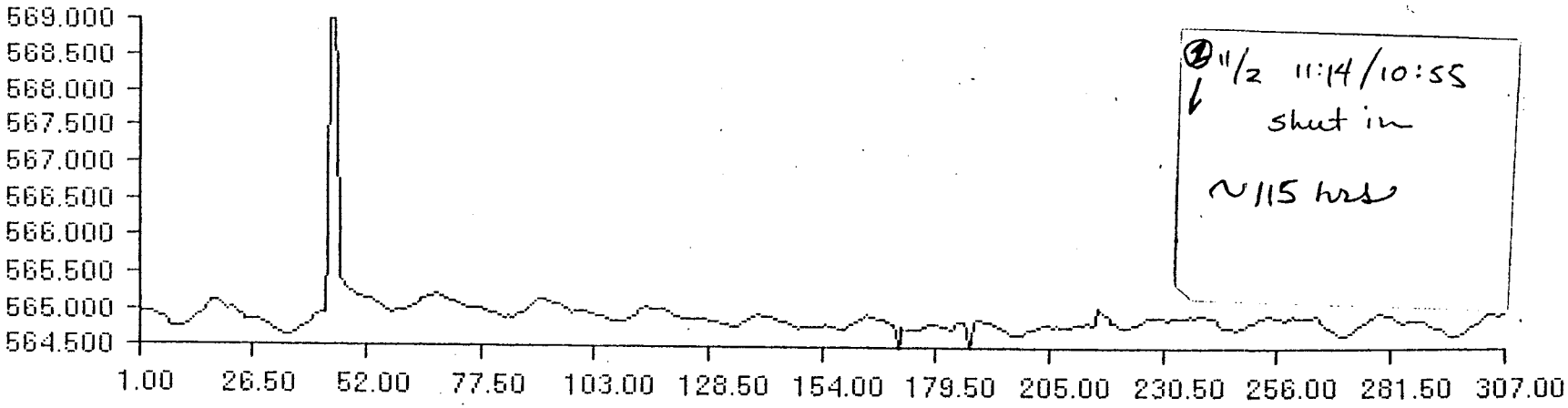


① @ ~718 hrs = 10/22
08:20/35
3" open

VS 9/22/1992 10: 0: 1
<S=SCALE> <M=MARK POINTS> <P=PRINT>

1LKASOH2.SUR
INTERVAL = 1 HR

10/28/92
15:21



② 11/2 11:14/10:55
shut in
~115 hrs

VS 10/28/1992 16: 0: 1
<S=SCALE> <M=MARK POINTS>

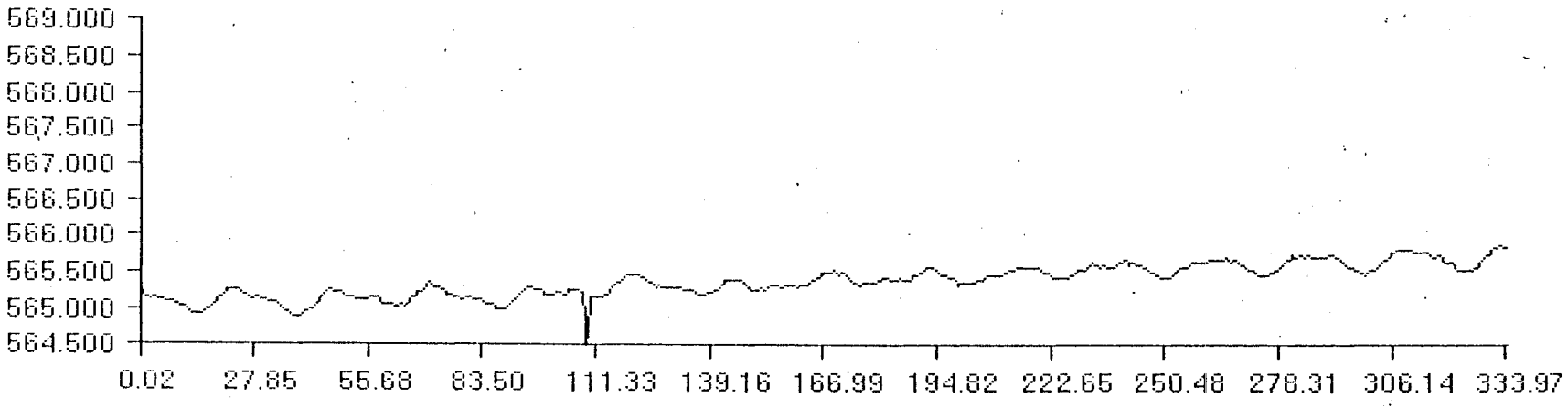
1MKASOH2.SUR
INTERVAL = 1HR

11/10/92
11:50
DISCONNECT DATALOGGER

10/30/92
PURGE
11:12
FITTING

↑ label graphs w/ time/hr
① purge

11/6/92
14:45
PURGE



VS 11/25/1992 11: 2: 1 10KASOH2.SUR

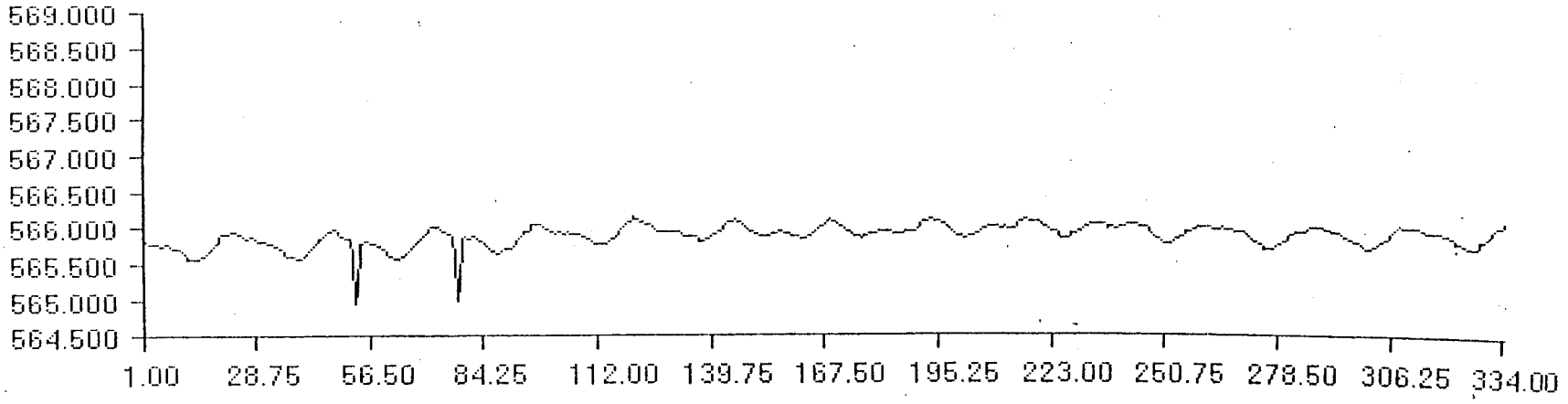
<S=SCALE> <M=MARK POINTS> <P=PRINT>

INTERVAL = 1 HR

14 DAYS

12/9/92
9:08

RECONNECT
DATALOGGER



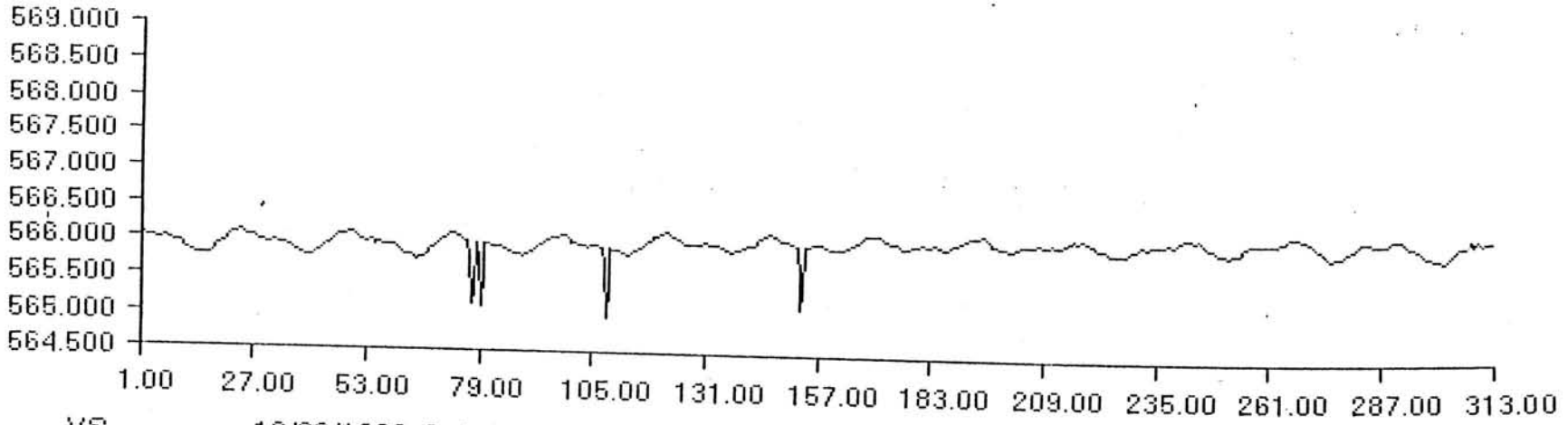
VS 12/ 9/1992 10: 0: 1 1PKASOH2.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

INTERVAL = 1 HR

14 DAYS

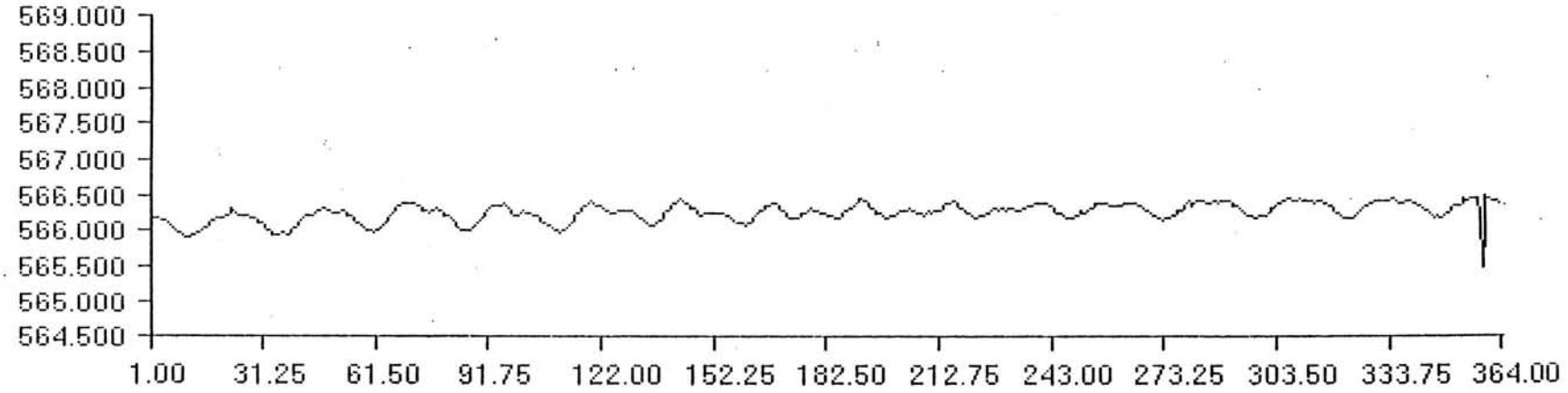
12/23/92
8:57



VS 12/23/1992 9: 0: 1
<S=SCALE> <M=MARK POINTS> <P=PRINT>

1QKASOH2.SUR
INTERVAL = 1 HR
13 DAYS

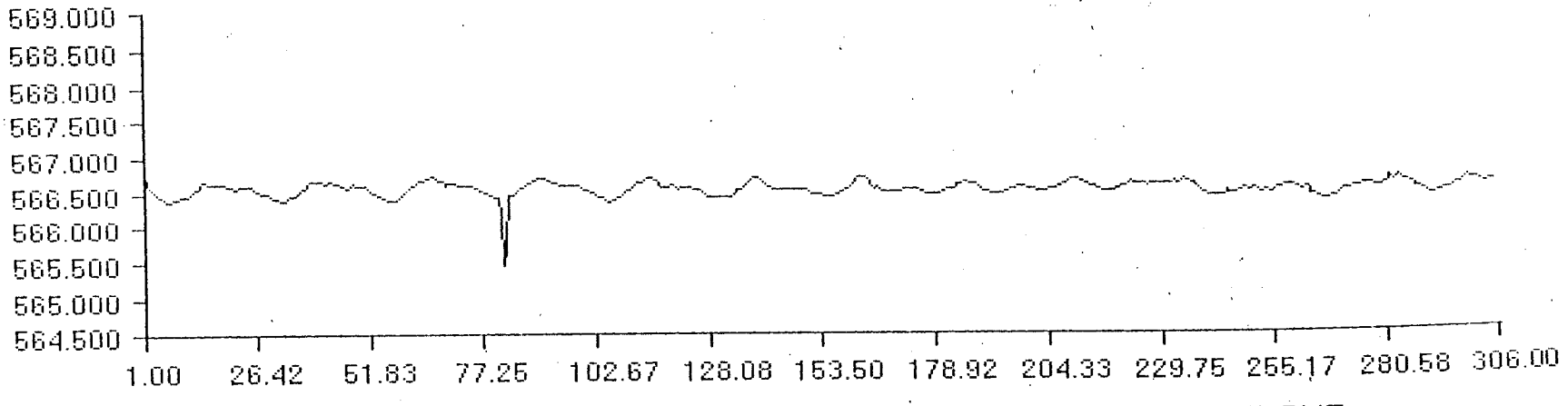
1/5/93
10:23



VS 1/ 5/1993 11: 0: 1
<S=SCALE> <M=MARK POINTS> <P=PRINT>

1RKASOH2.SUR
INTERVAL = 1 HR
15 DAYS

1/20/93
16:03



VS 1/20/1993 16: 0: 1 1SKASOH2.SUR

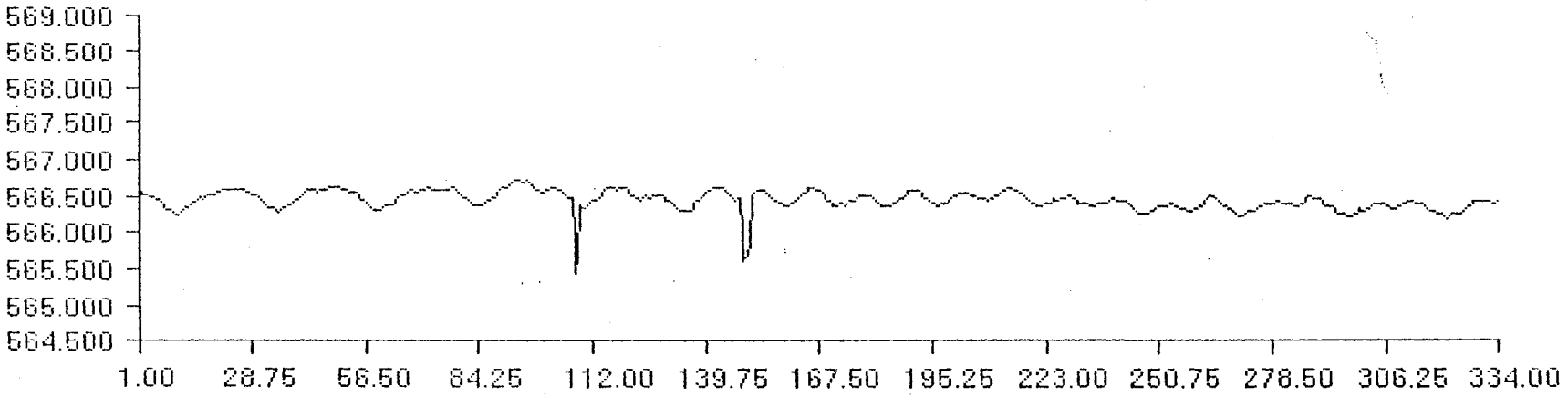
<S=SCALE> <M=MARK POINTS> <P=PRINT>

INTERVAL = 1 HR

13 DAYS

2/2/93

10:05



VS 2/ 2/1993 11: 0: 1 1TKASOH2.SUR

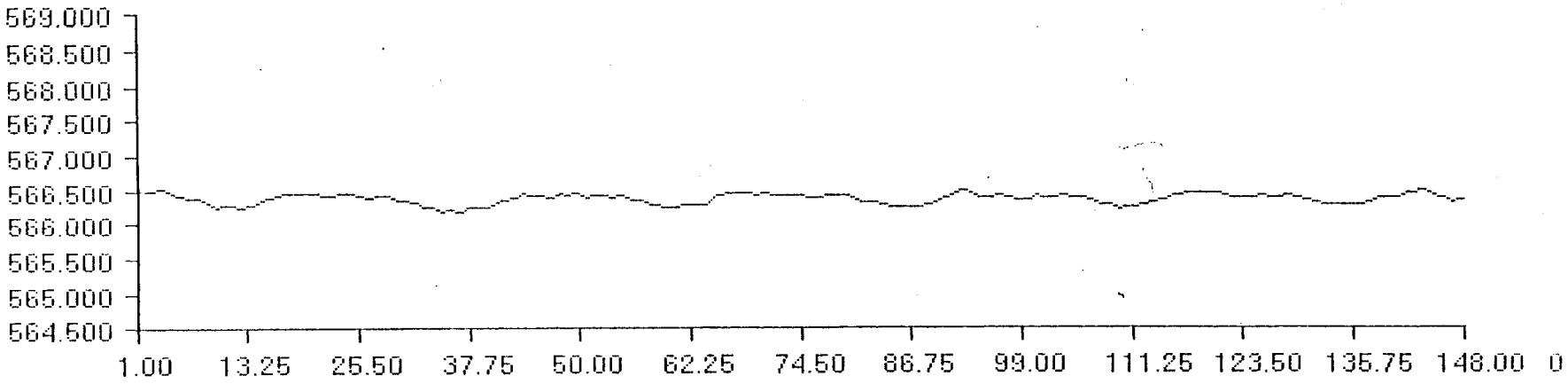
<S=SCALE> <M=MARK POINTS> <P=PRINT>

INTERVAL = 1 HR

14 DAYS

2/16/93

9:32



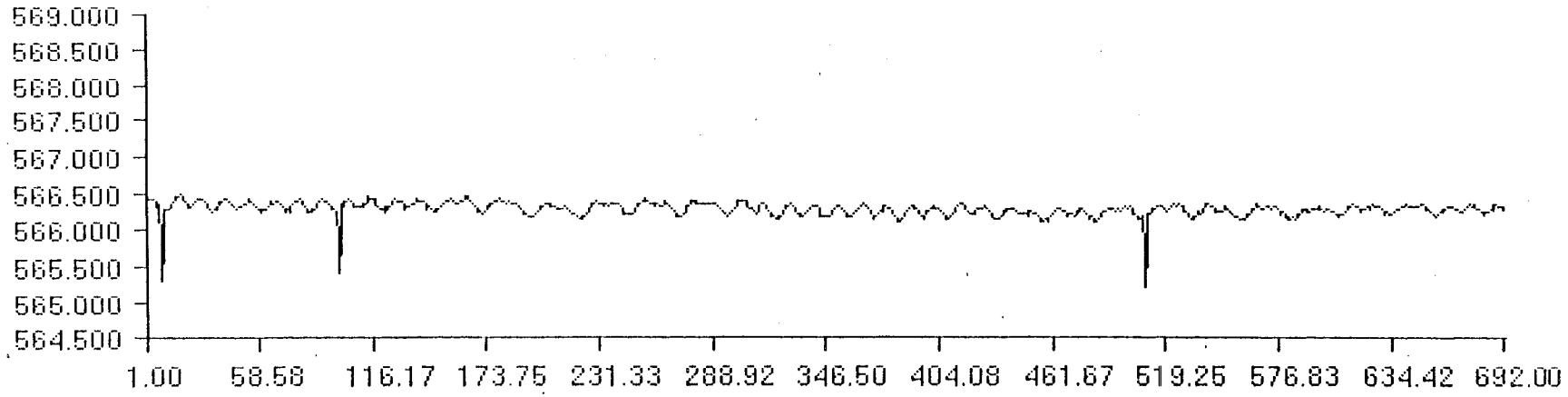
VS 2/16/1993 10: 0: 1 1UKASOH2.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

interval = 1 hour

6 days

2/22/93
1433



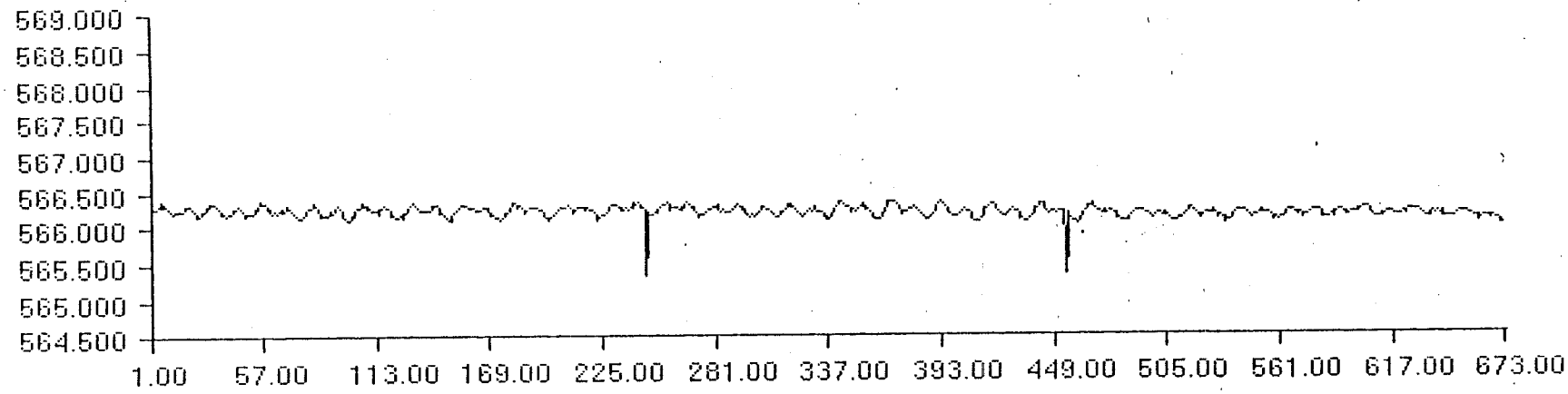
VS 2/22/1993 15: 0: 1 1VKASOH2.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

Interval = 1 hr

29 days

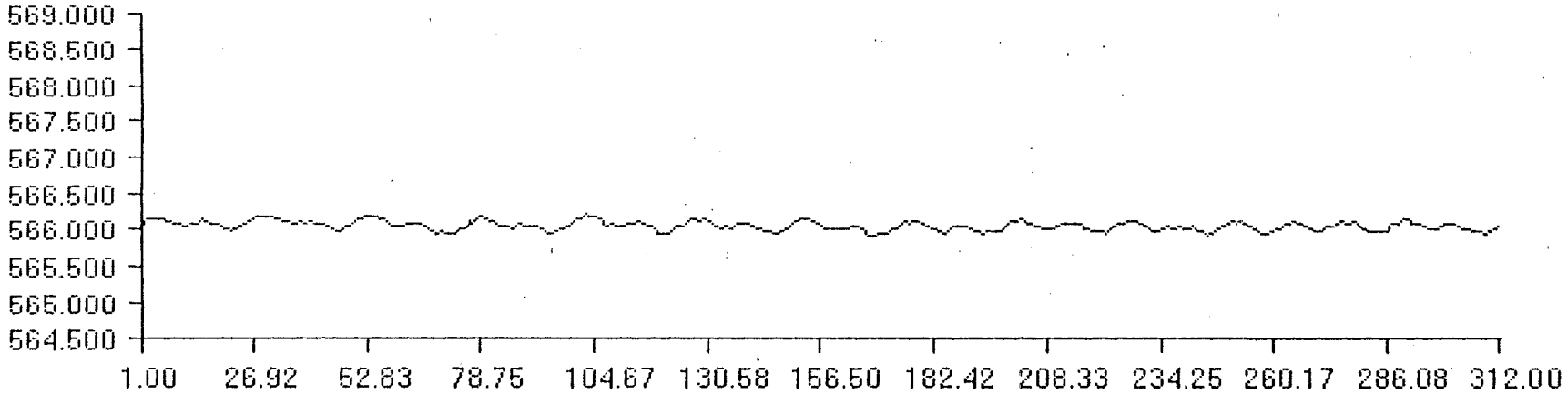
3/23/93
11:51



VS 3/23/1993 12: 0: 1 1WKASOH2.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

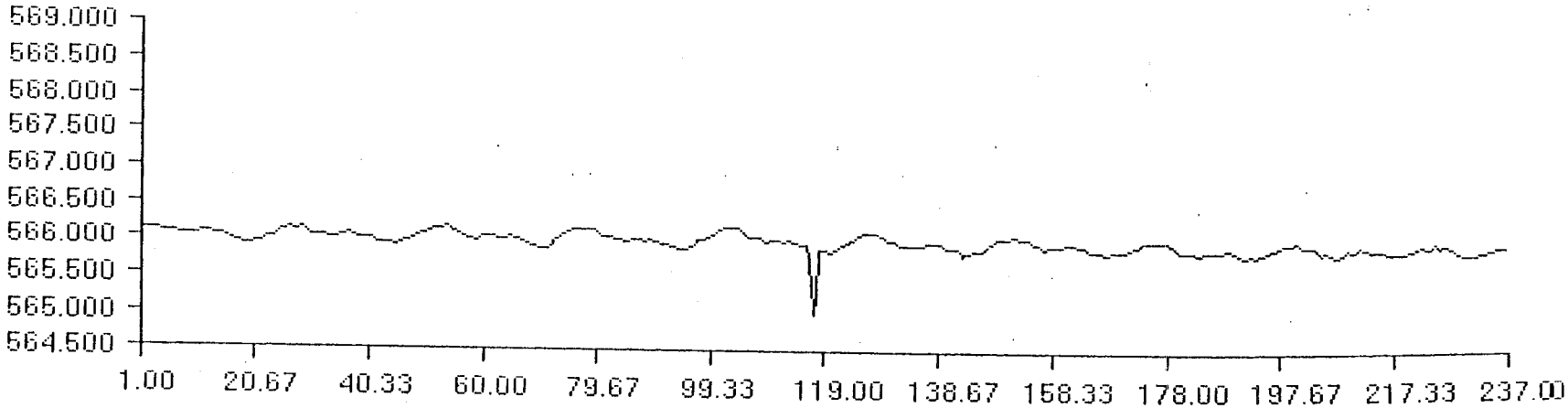
Interval= 1hr.
28 days
4/20/93
13:22



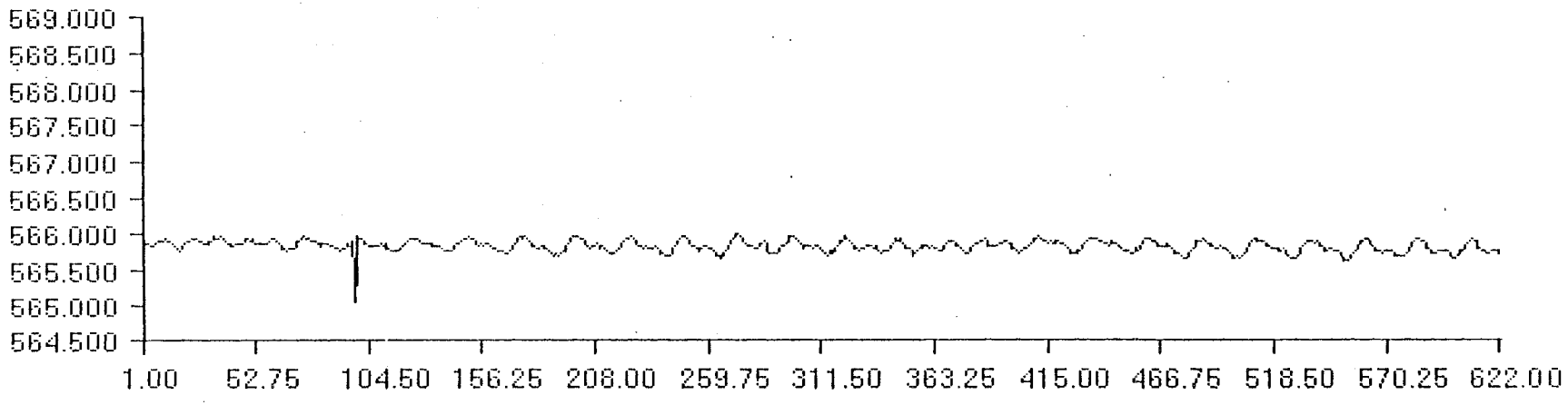
VS 4/20/1993 14: 0: 1 1XKASOH2.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

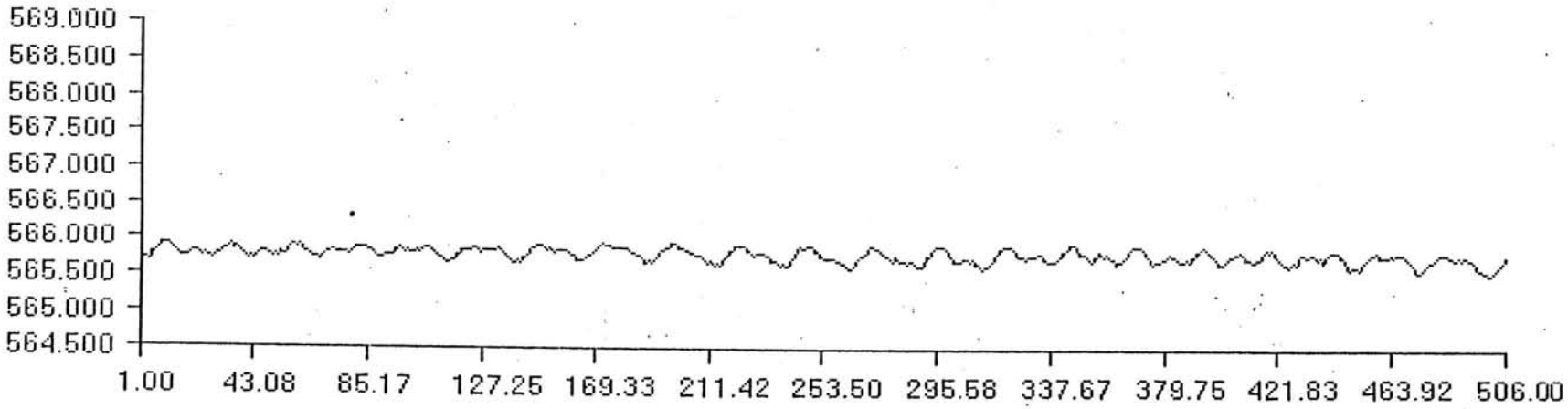
Interval= 1hr
13 days



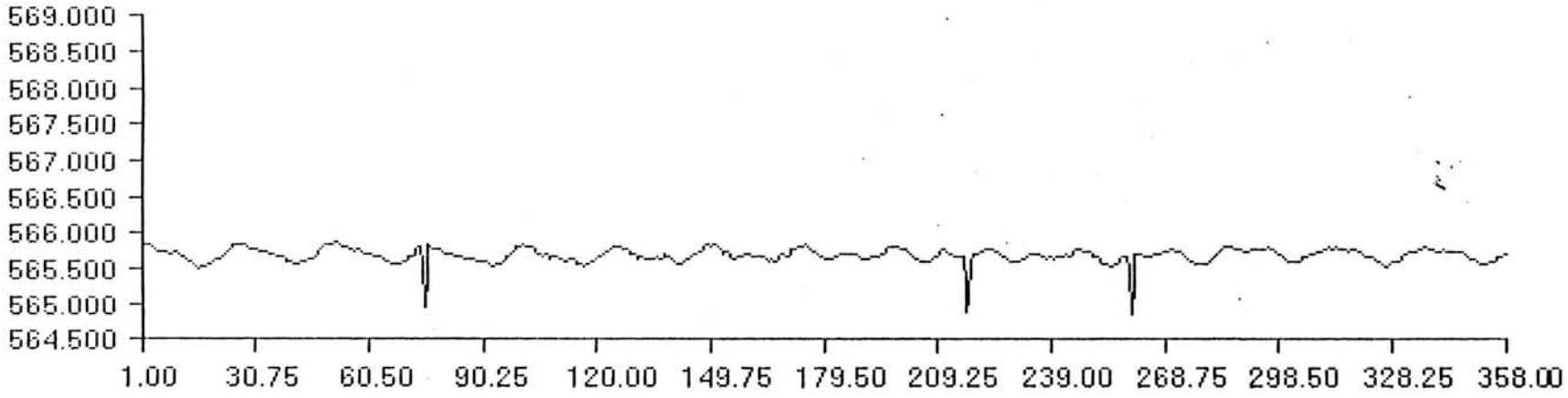
Interval = 1 hr.
10 days
5/13/93



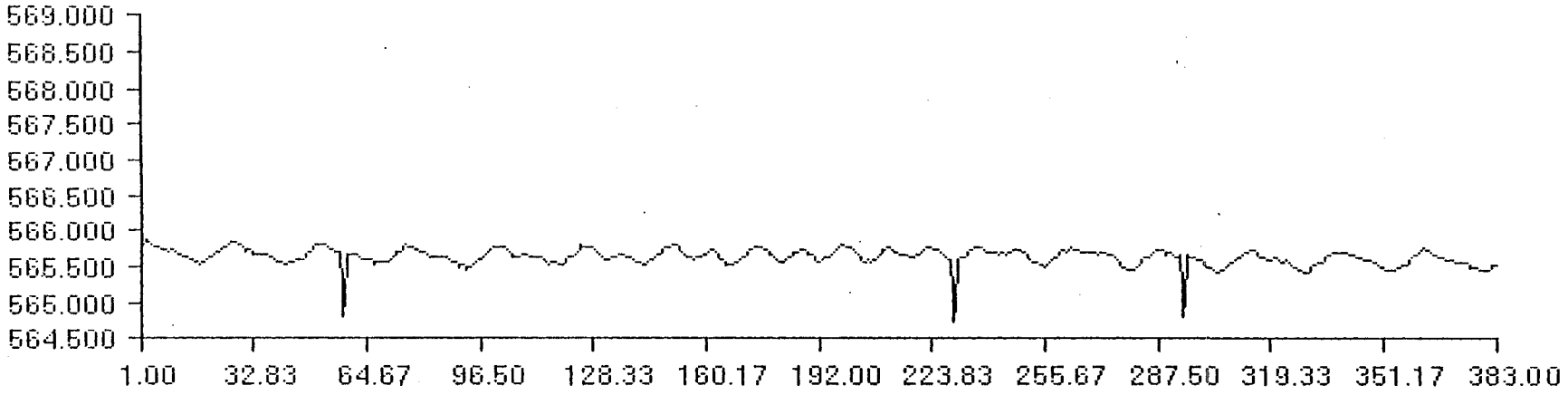
Interval = 1 hr.
26 days
6/8/93 11:00



Interval = 1 hr
21 days
6/29/93 14:00



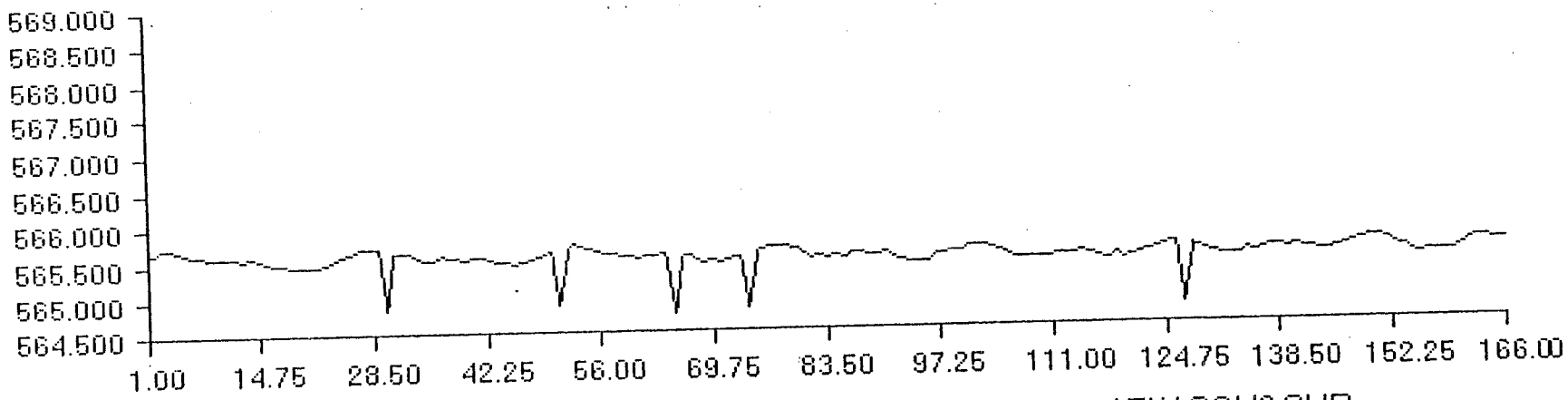
Interval = 1 hour
15 days
7/14/93 1335 hrs



VS 7/14/1993 14: 0: 1 1DKASOH2.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

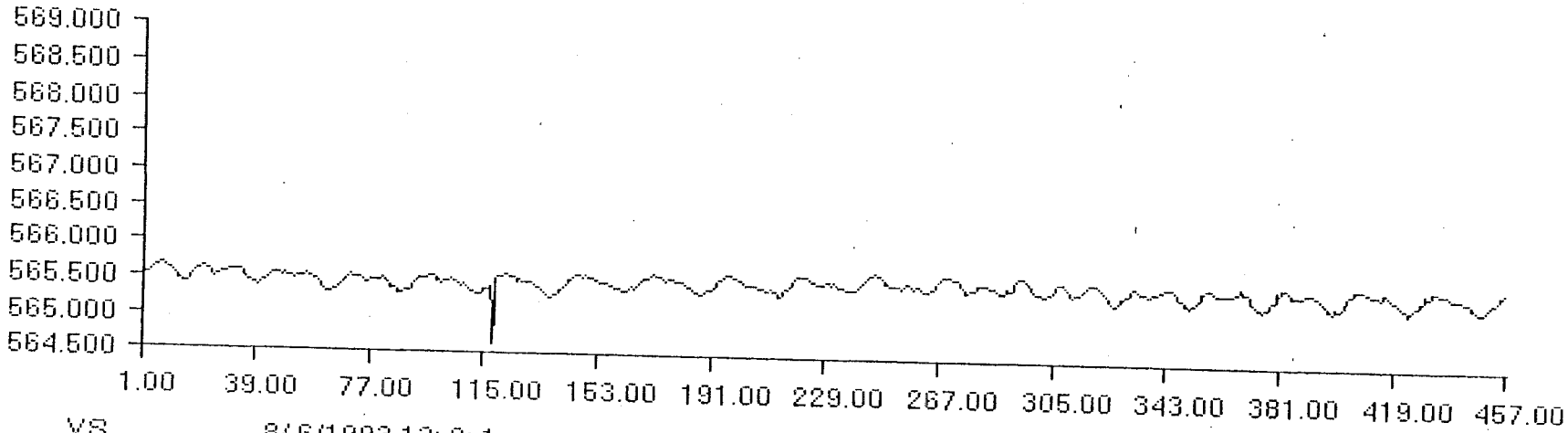
Interval = 1 hr.
1½ days
7/30/93 13:10



VS 7/30/1993 14: 0: 1 1EKASOH2.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

Interval = 1 hr.
8/6/93
7 days

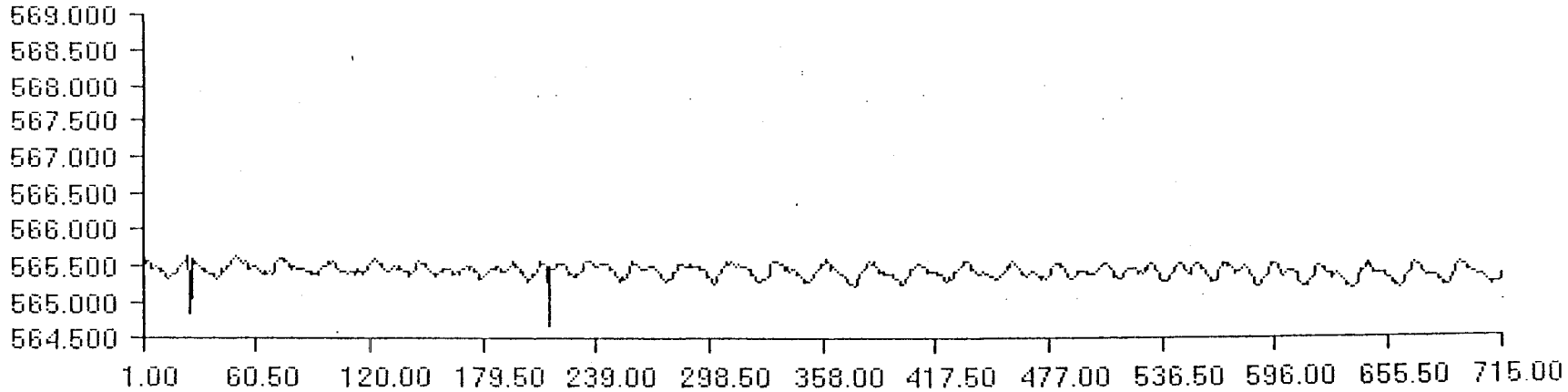


VS 8/ 6/1993 13: 0: 1

<S=SCALE> <M=MARK POINTS> <P=PRINT>

1FKASOH2.SUR

Interval = 1 hr.
19 days
8/25/93

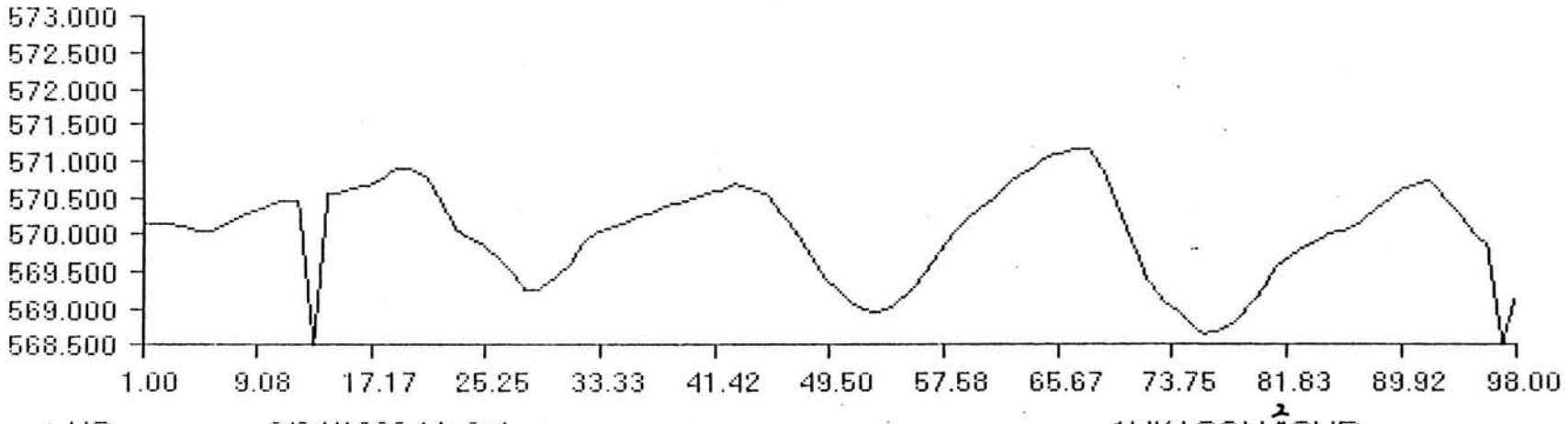


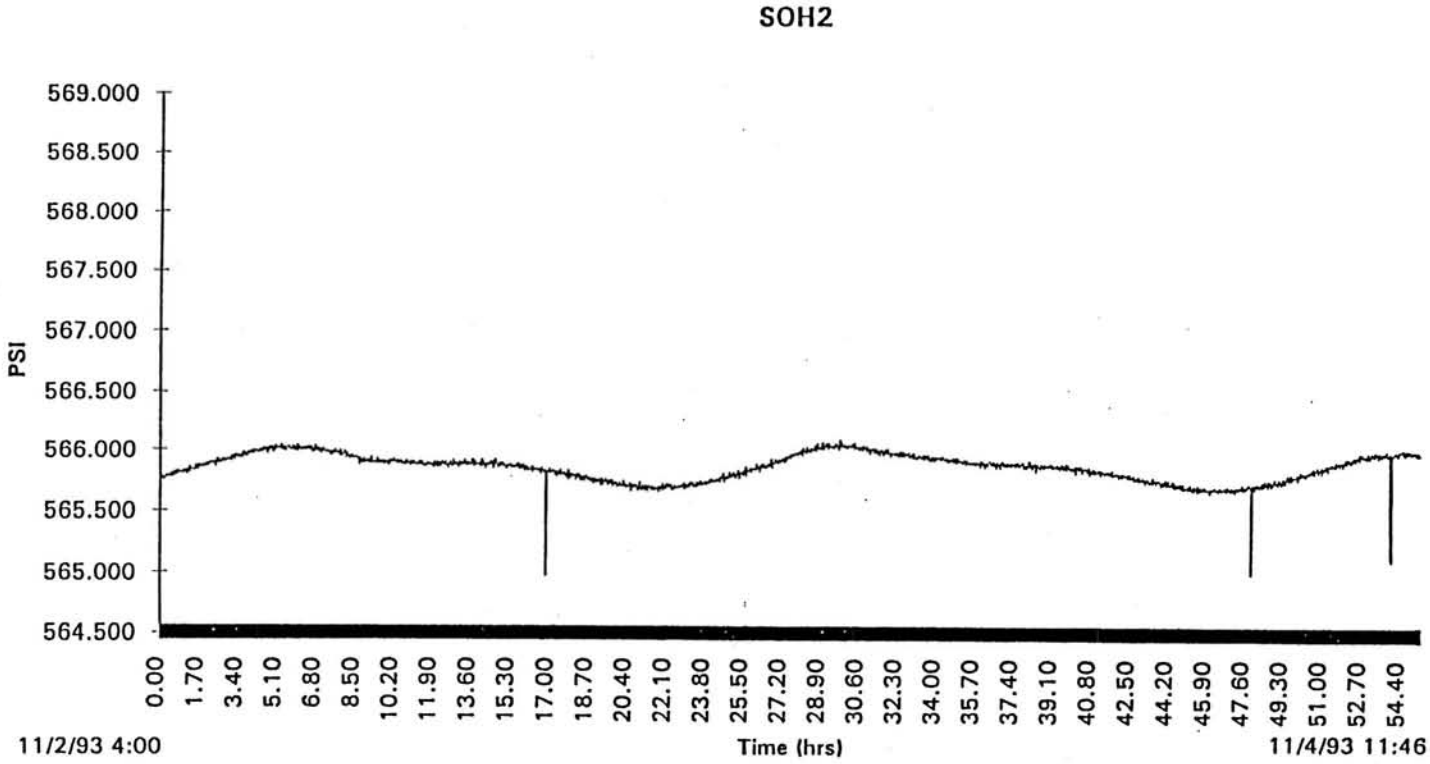
VS 8/25/1993 15: 0: 1

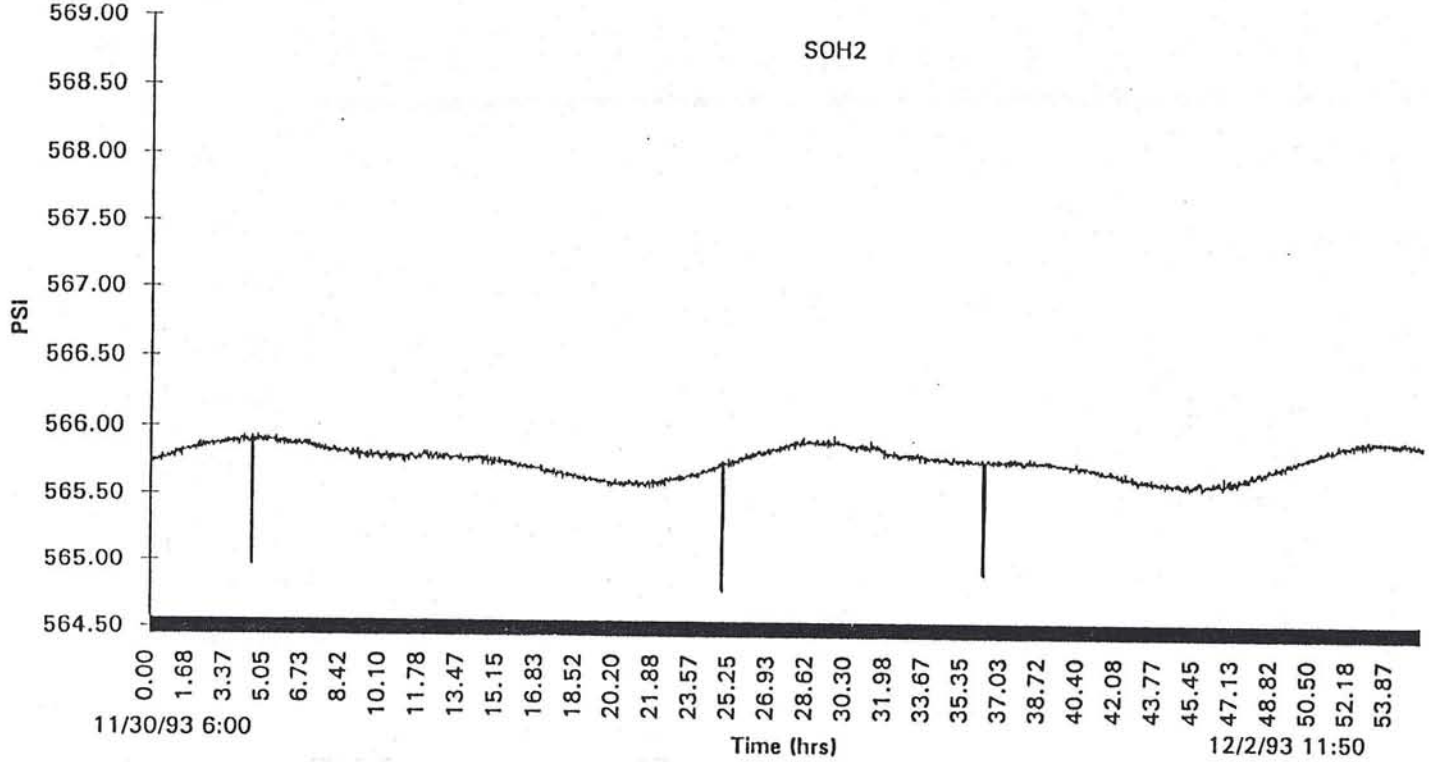
<S=SCALE> <M=MARK POINTS> <P=PRINT>

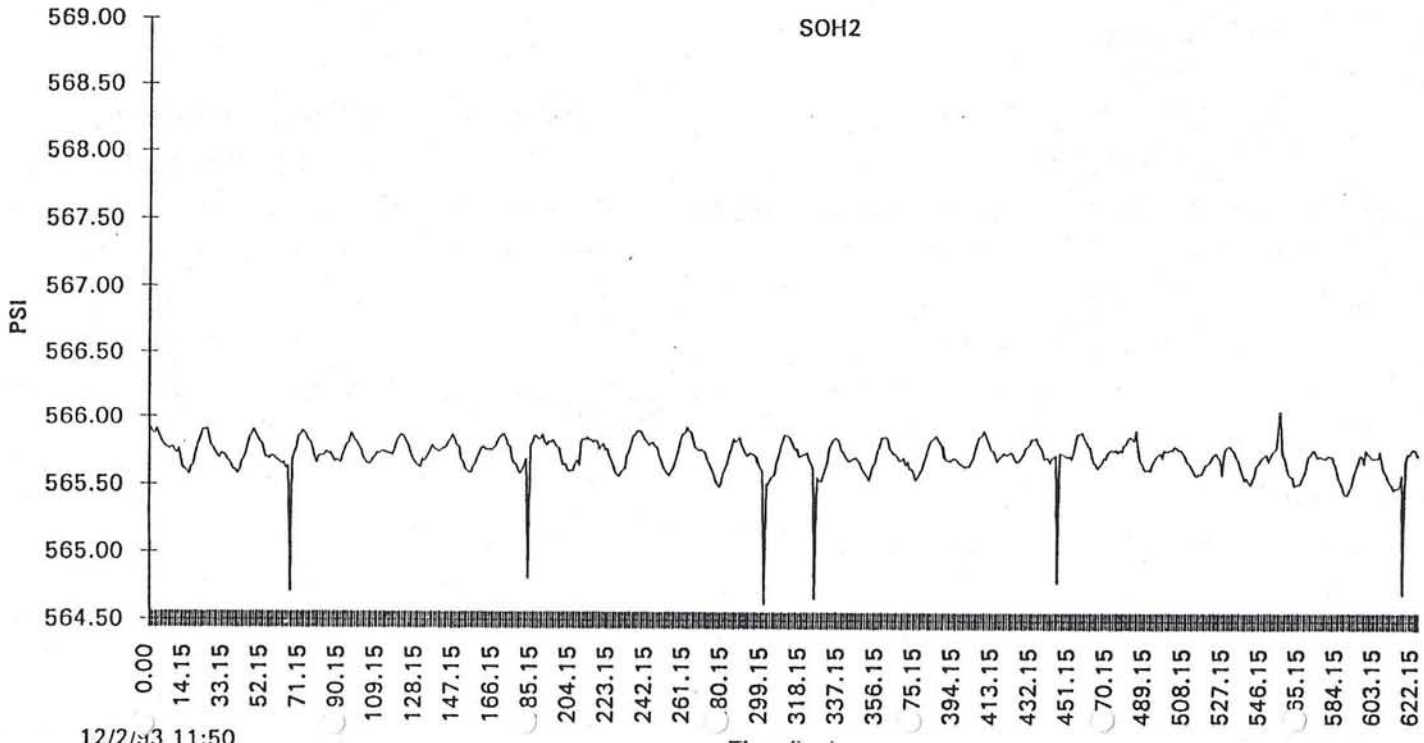
1GKASOH2.SUR

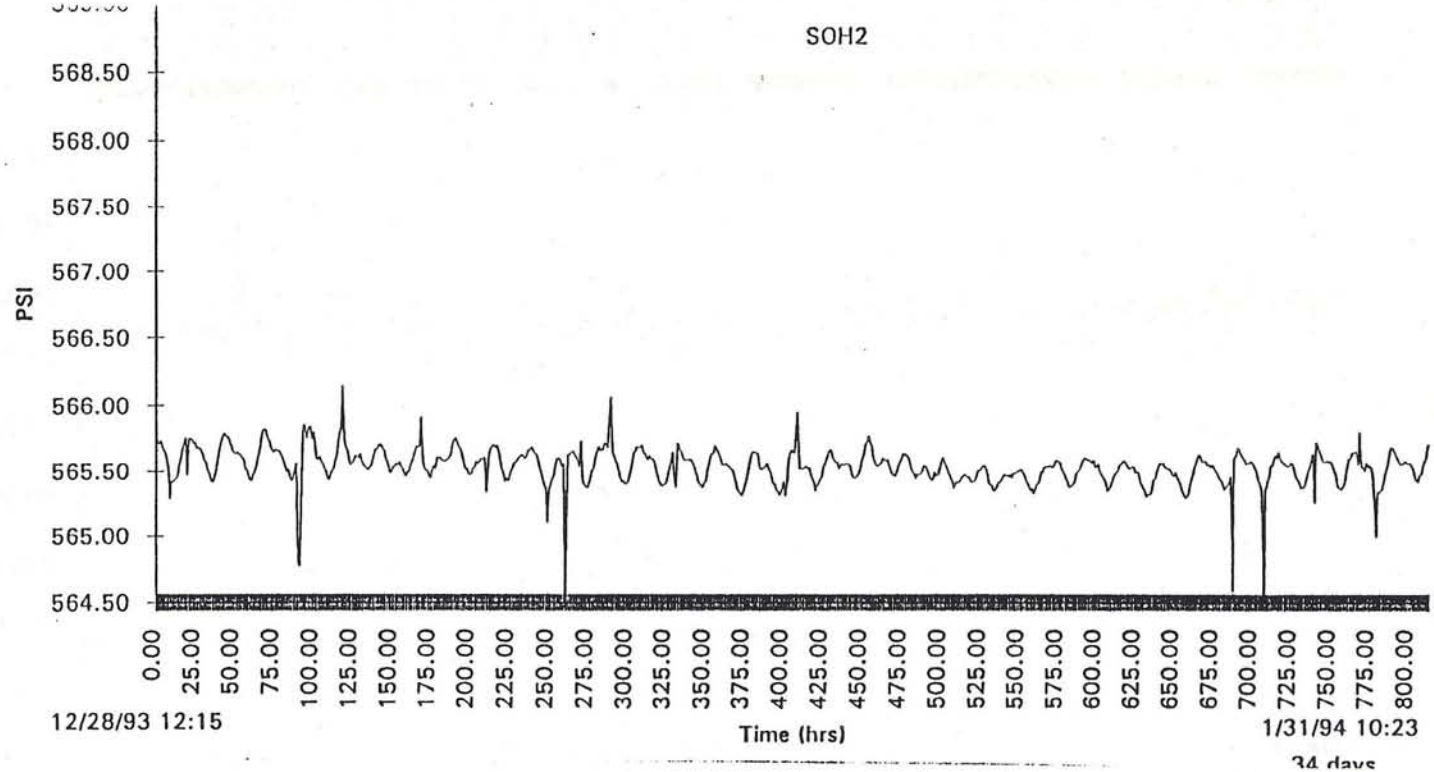
Interval = 1hr.
30 days
9/24/93 10:55

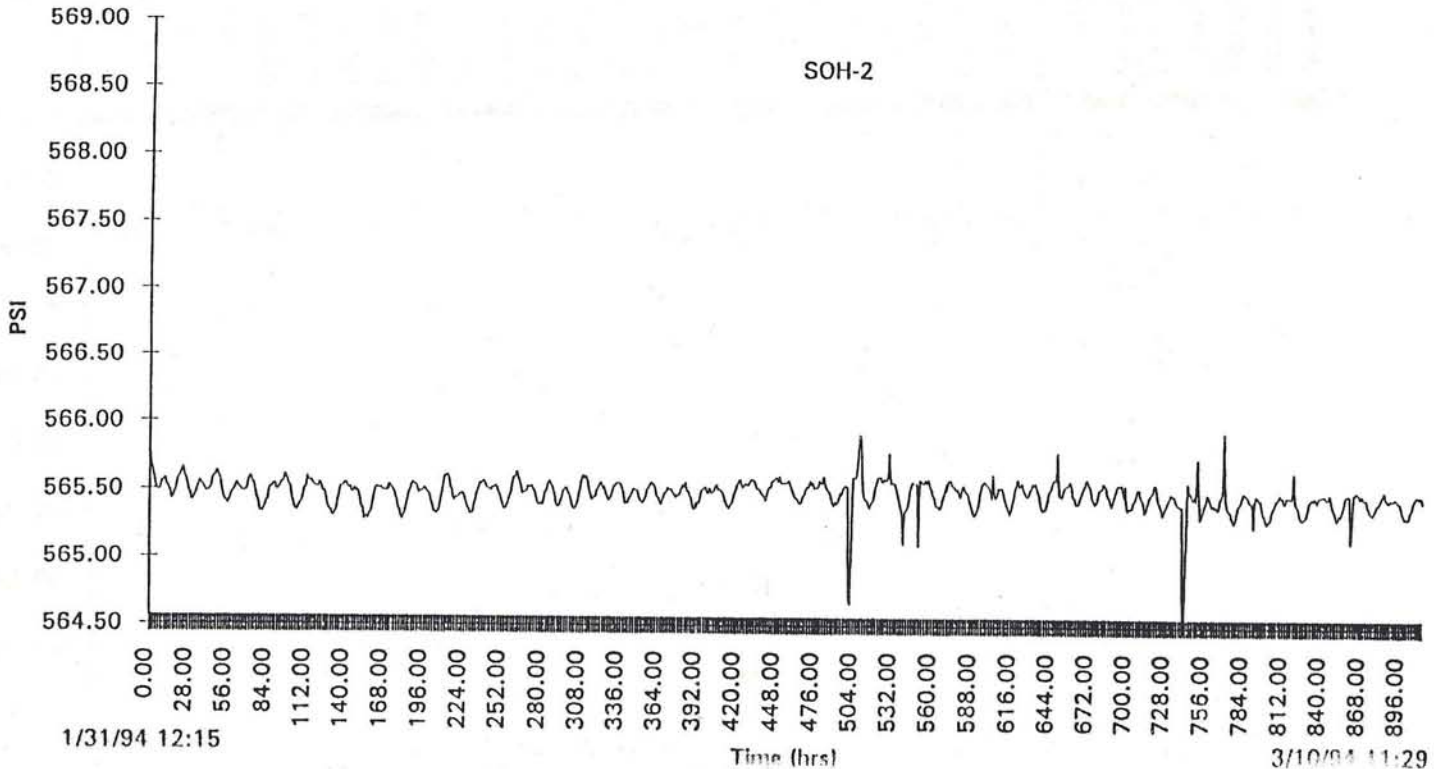

573.000
572.500
572.000
571.500
571.000
570.500
570.000
569.500
569.000
568.500
1.00
9.08
17.17
25.25
33.33
41.42
49.50
57.58
65.67
73.75
81.83
89.92
98.00
VS
9/24/1993 11: 0: 1
1HKASOH2.SUR
<S=SCALE> <M=MARK POINTS> <P=PRINT>
±4 psi
Interval = 1hr.
3 days
9/28/93 13:50

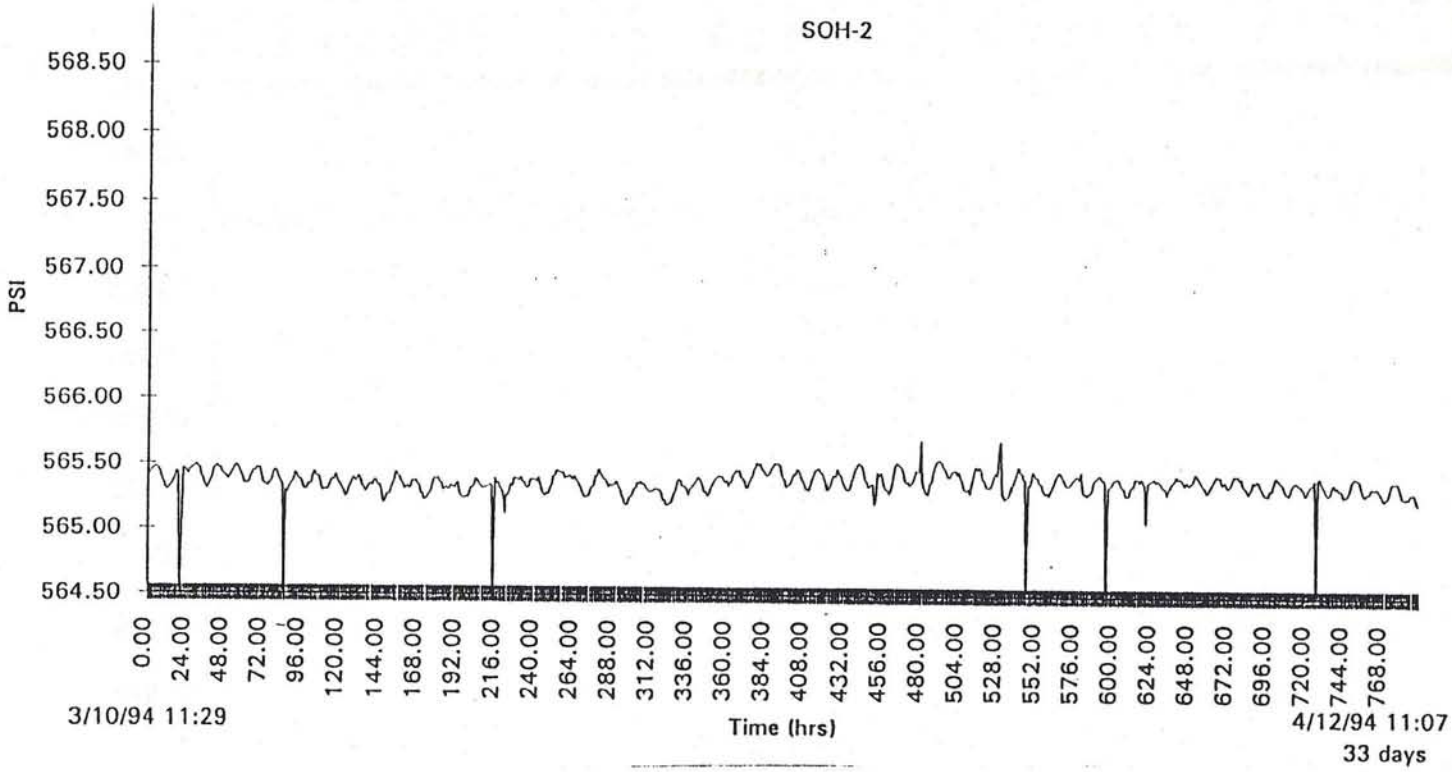

SOH2
PSI
569.000
568.500
568.000
567.500
567.000
566.500
566.000
565.500
565.000
564.500
0.00
1.70
3.40
5.10
6.80
8.50
10.20
11.90
13.60
15.30
17.00
18.70
20.40
22.10
23.80
25.50
27.20
28.90
30.60
32.30
34.00
35.70
37.40
39.10
40.80
42.50
44.20
45.90
47.60
49.30
51.00
52.70
54.40
11/2/93 4:00
Time (hrs)
11/4/93 11:46

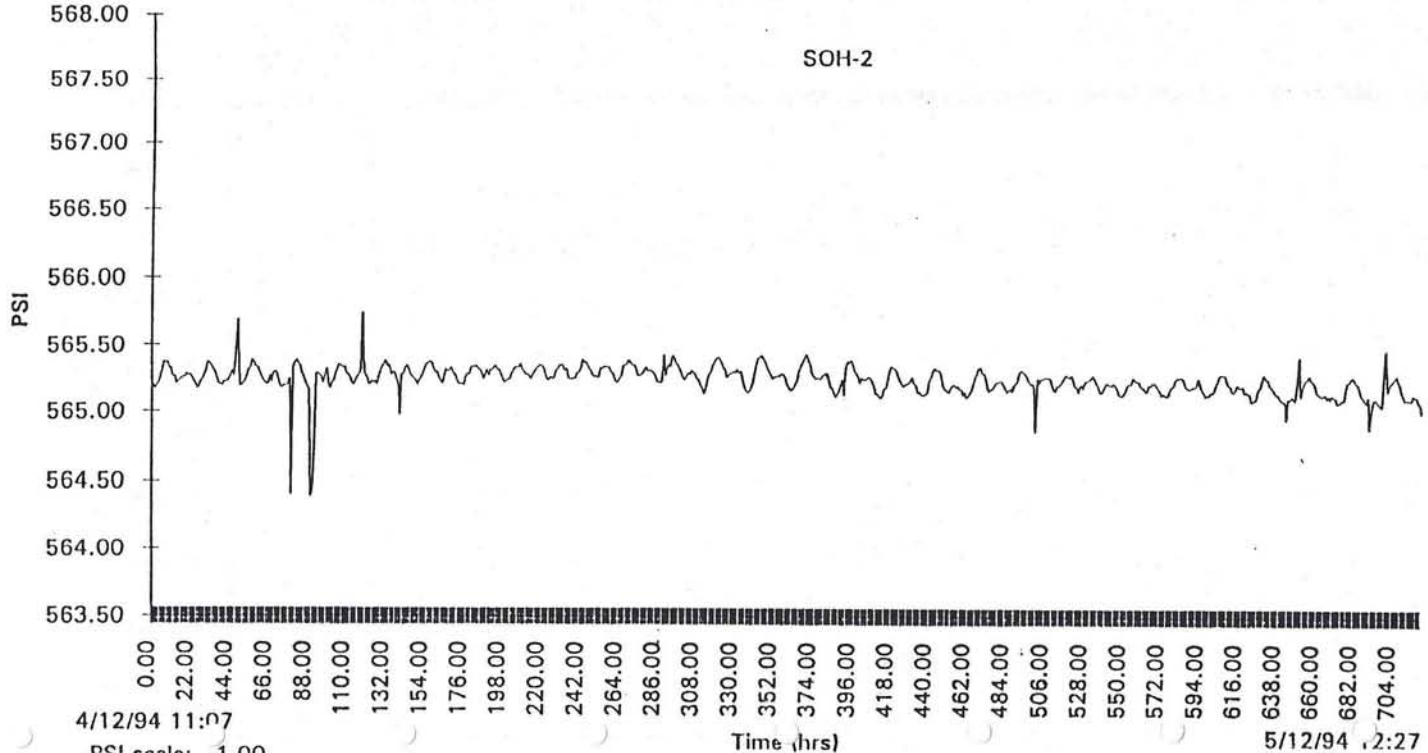

SOH2
PSI
569.00
568.50
568.00
567.50
567.00
566.50
566.00
565.50
565.00
564.50
0.00 1.68 3.37 5.05 6.73 8.42 10.10 11.78 13.47 15.15 16.83 18.52 20.20 21.88 23.57 25.25 26.93 28.62 30.30 31.98 33.67 35.35 37.03 38.72 40.40 42.08 43.77 45.45 47.13 48.82 50.50 52.18 53.87
11/30/93 6:00
Time (hrs)
12/2/93 11:50

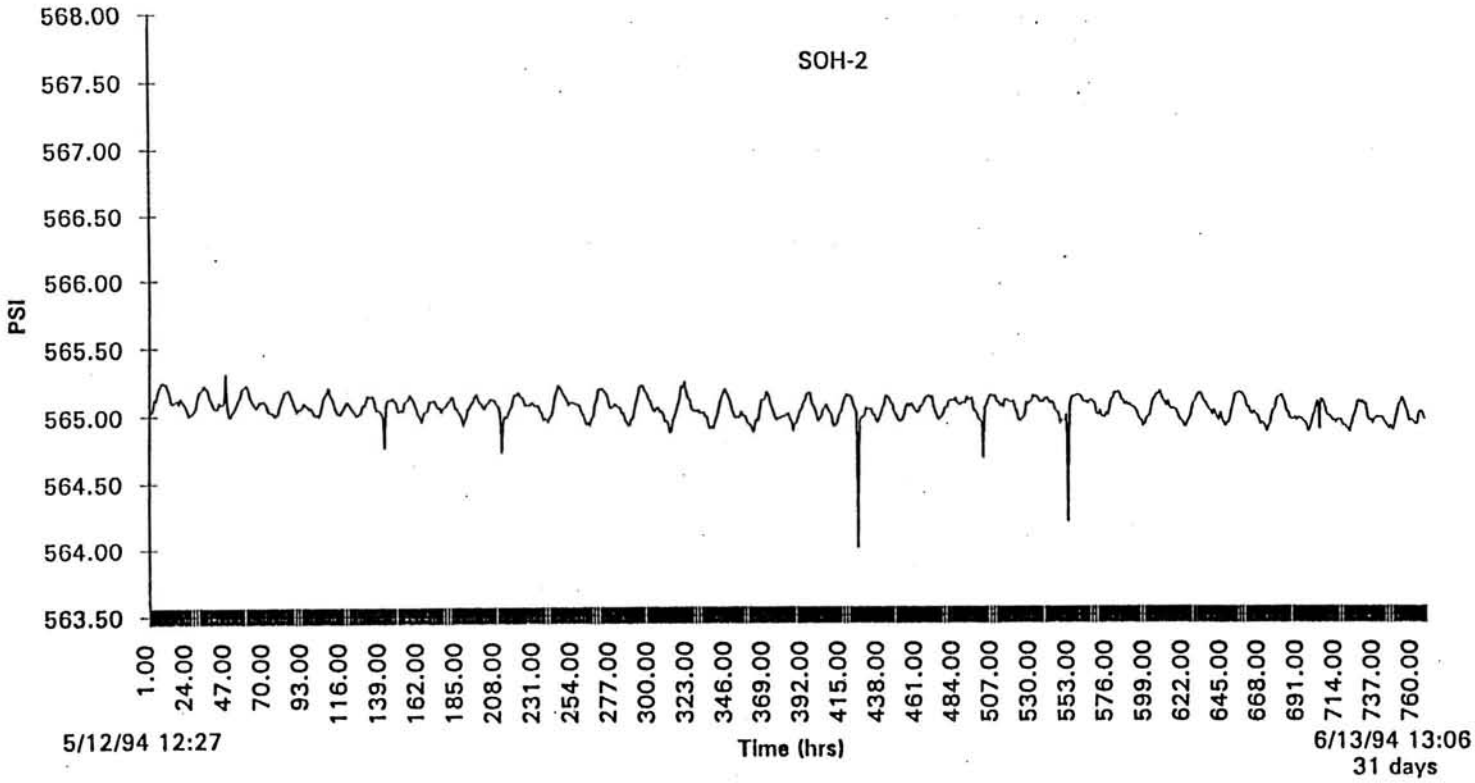

SOH2
PSI
569.00
568.50
568.00
567.50
567.00
566.50
566.00
565.50
565.00
564.50
0.00 14.15 33.15 52.15 71.15 90.15 109.15 128.15 147.15 166.15 85.15 204.15 223.15 242.15 261.15 80.15 299.15 318.15 337.15 356.15 75.15 394.15 413.15 432.15 451.15 70.15 489.15 508.15 527.15 546.15 55.15 584.15 603.15 622.15
12/2/93 11:50

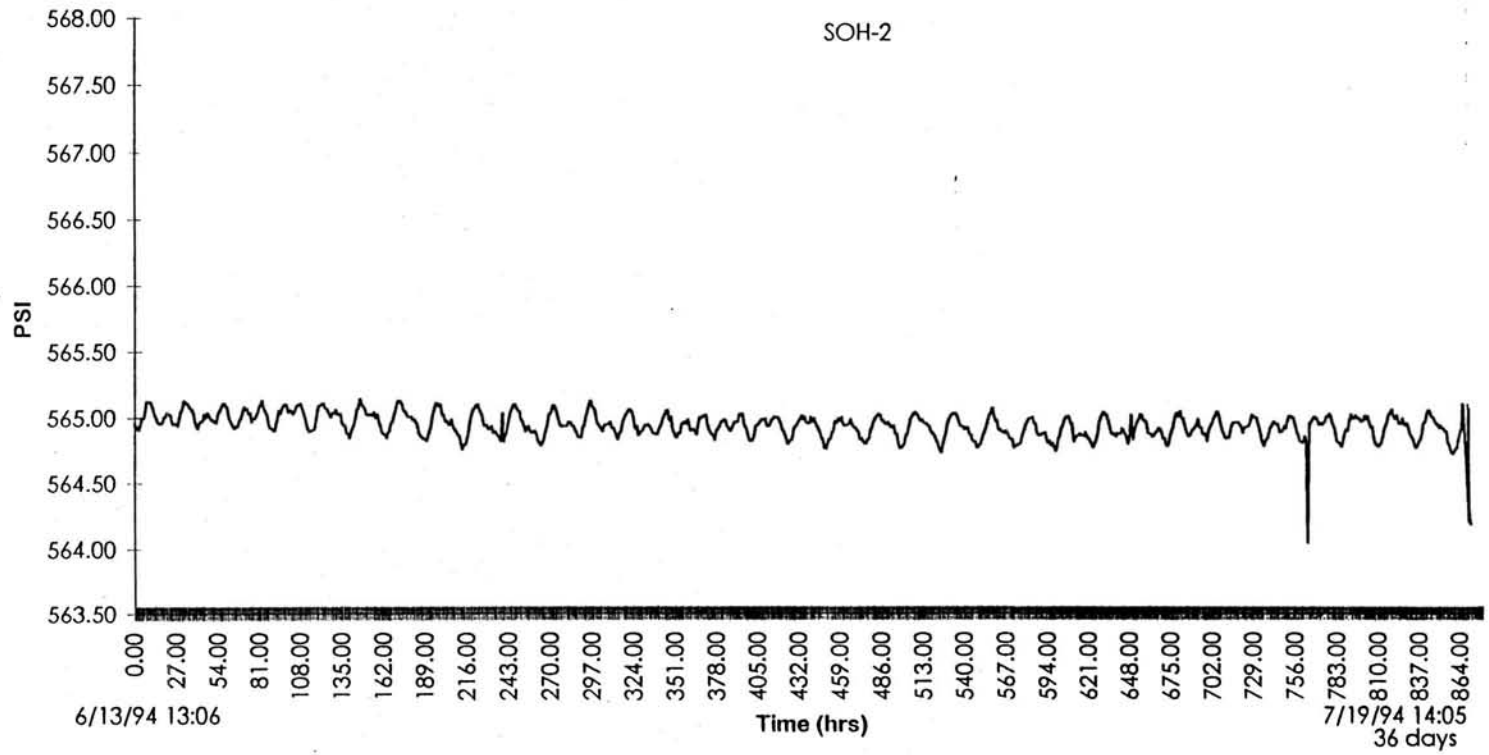

SOH2
PSI
568.50
568.00
567.50
567.00
566.50
566.00
565.50
565.00
564.50
0.00 25.00 50.00 75.00 100.00 125.00 150.00 175.00 200.00 225.00 250.00 275.00 300.00 325.00 350.00 375.00 400.00 425.00 450.00 475.00 500.00 525.00 550.00 575.00 600.00 625.00 650.00 675.00 700.00 725.00 750.00 775.00 800.00
12/28/93 12:15
Time (hrs)
1/31/94 10:23
34 days


SOH-2
PSI
569.00
568.50
568.00
567.50
567.00
566.50
566.00
565.50
565.00
564.50
0.00 28.00 56.00 84.00 112.00 140.00 168.00 196.00 224.00 252.00 280.00 308.00 336.00 364.00 392.00 420.00 448.00 476.00 504.00 532.00 560.00 588.00 616.00 644.00 672.00 700.00 728.00 756.00 784.00 812.00 840.00 868.00 896.00
1/31/94 12:15
Time (hrs)
3/10/94 11:29


SOH-2
PSI
568.50
568.00
567.50
567.00
566.50
566.00
565.50
565.00
564.50
0.00
24.00
48.00
72.00
96.00
120.00
144.00
168.00
192.00
216.00
240.00
264.00
288.00
312.00
336.00
360.00
384.00
408.00
432.00
456.00
480.00
504.00
528.00
552.00
576.00
600.00
624.00
648.00
672.00
696.00
720.00
744.00
768.00
3/10/94 11:29
Time (hrs)
4/12/94 11:07
33 days

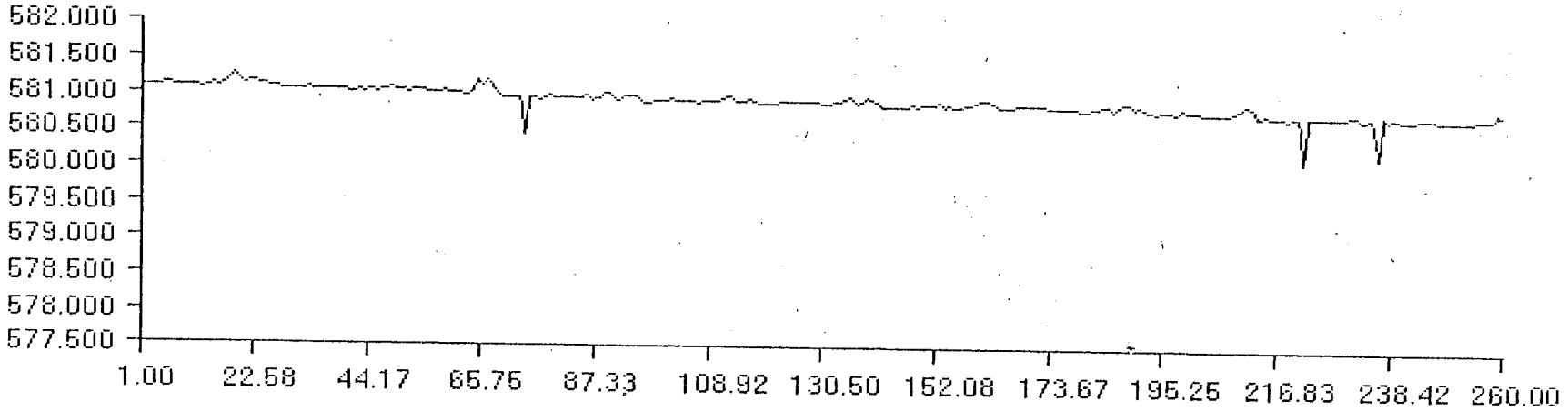

SOH-2
PSI
568.00
567.50
567.00
566.50
566.00
565.50
565.00
564.50
564.00
563.50
0.00
22.00
44.00
66.00
88.00
110.00
132.00
154.00
176.00
198.00
220.00
242.00
264.00
286.00
308.00
330.00
352.00
374.00
396.00
418.00
440.00
462.00
484.00
506.00
528.00
550.00
572.00
594.00
616.00
638.00
660.00
682.00
704.00
4/12/94 11:07
Time (hrs)
5/12/94 12:27


SOH-2
PSI
568.00
567.50
567.00
566.50
566.00
565.50
565.00
564.50
564.00
563.50
1.00
24.00
47.00
70.00
93.00
116.00
139.00
162.00
185.00
208.00
231.00
254.00
277.00
300.00
323.00
346.00
369.00
392.00
415.00
438.00
461.00
484.00
507.00
530.00
553.00
576.00
599.00
622.00
645.00
668.00
691.00
714.00
737.00
760.00
5/12/94 12:27
Time (hrs)
6/13/94 13:06
31 days


SOH-2
568.00
567.50
567.00
566.50
566.00
565.50
565.00
564.50
564.00
563.50
PSI
0.00
27.00
54.00
81.00
108.00
135.00
162.00
189.00
216.00
243.00
270.00
297.00
324.00
351.00
378.00
405.00
432.00
459.00
486.00
513.00
540.00
567.00
594.00
621.00
648.00
675.00
702.00
729.00
756.00
783.00
810.00
837.00
864.00
6/13/94 13:06
Time (hrs)
7/19/94 14:05
36 days

APPENDIX II

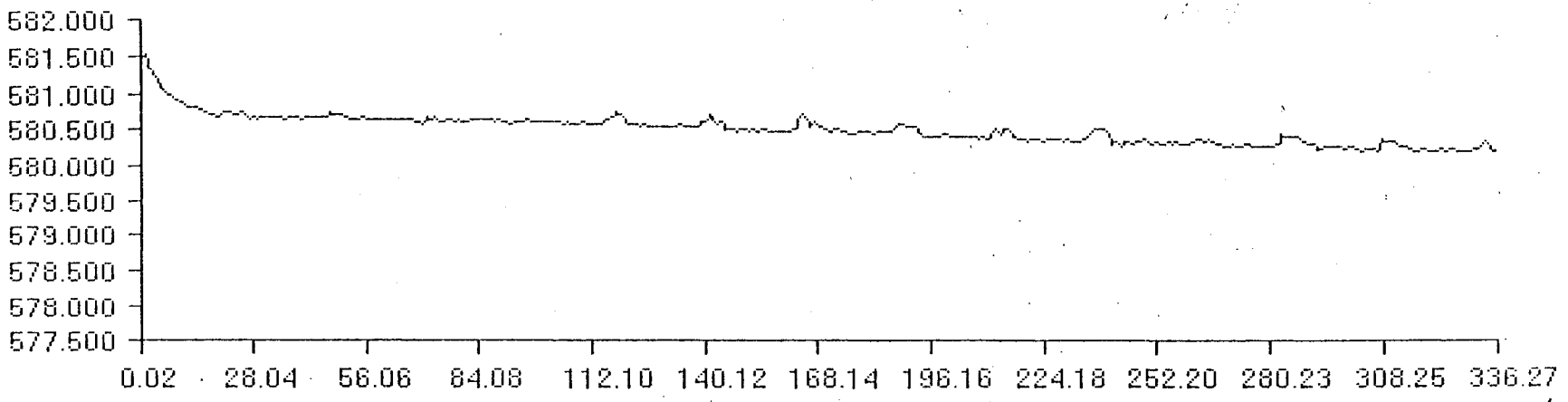
Graph of SOH-4 Pressure Data



VS 6/12/1992 17: 0: 1
<S=SCALE> <M=MARK POINTS> <P=PRINT>

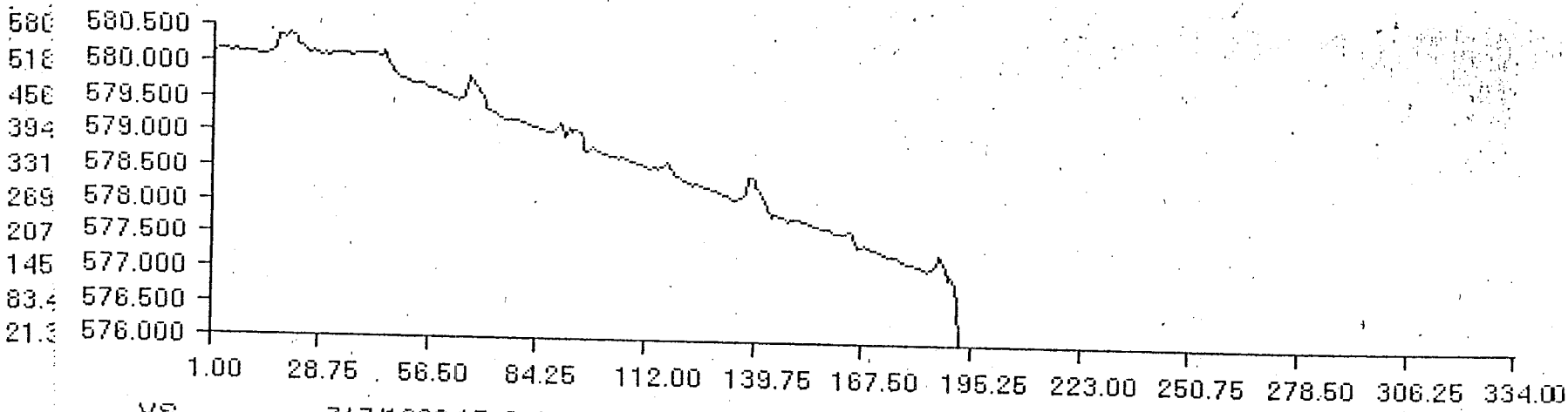
1AKASOH4.SUR 6/23/92
INTERVAL = 1 HR 13: 12

INSTALLED



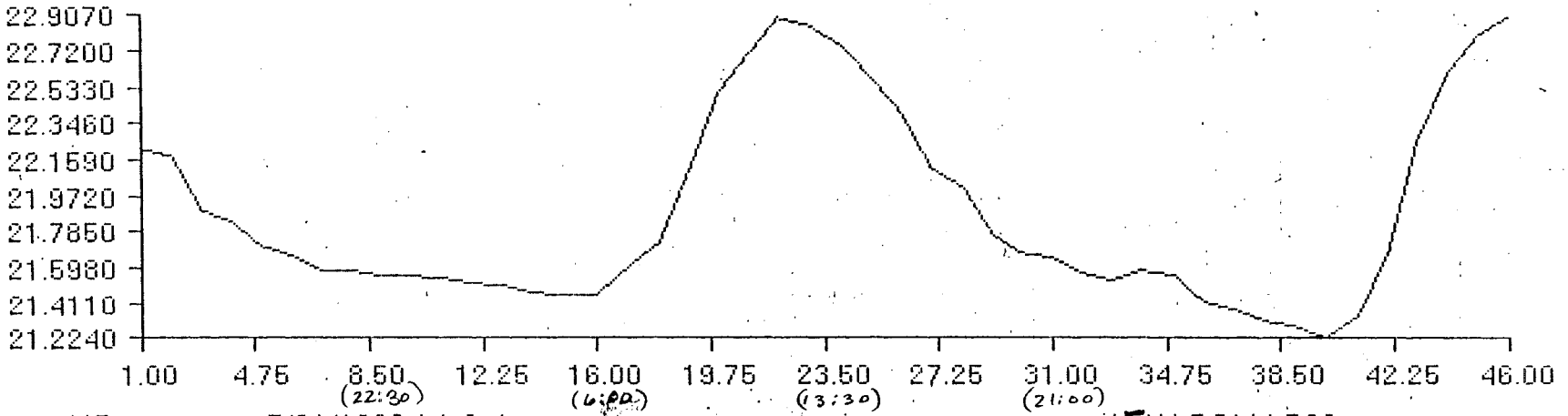
VS 6/23/1992 13:44: 1
<S=SCALE> <M=MARK POINTS> <P=PRINT>

1EKASOH4.SUR 7/7/92
INTERVAL = 1HR 14:07



7/15/92
14:17
Close in cap tubing

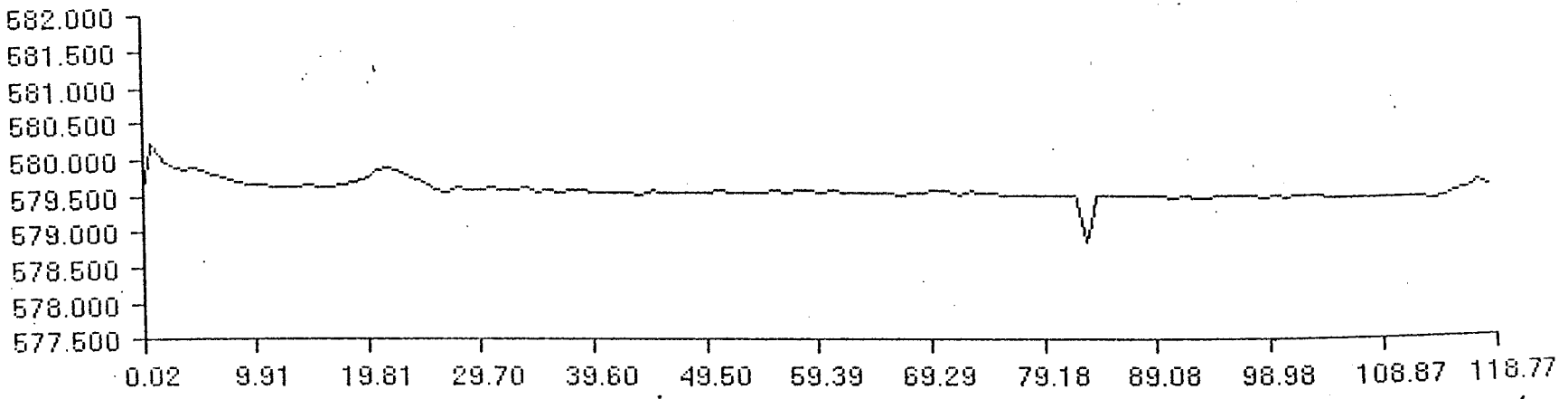
7/21/92
13:00



Datalog. D4
Interval = 1 hr

7/23/92
12:14

Datal collected from surface pressure transducer reading cap tubing at spool
39 wraps



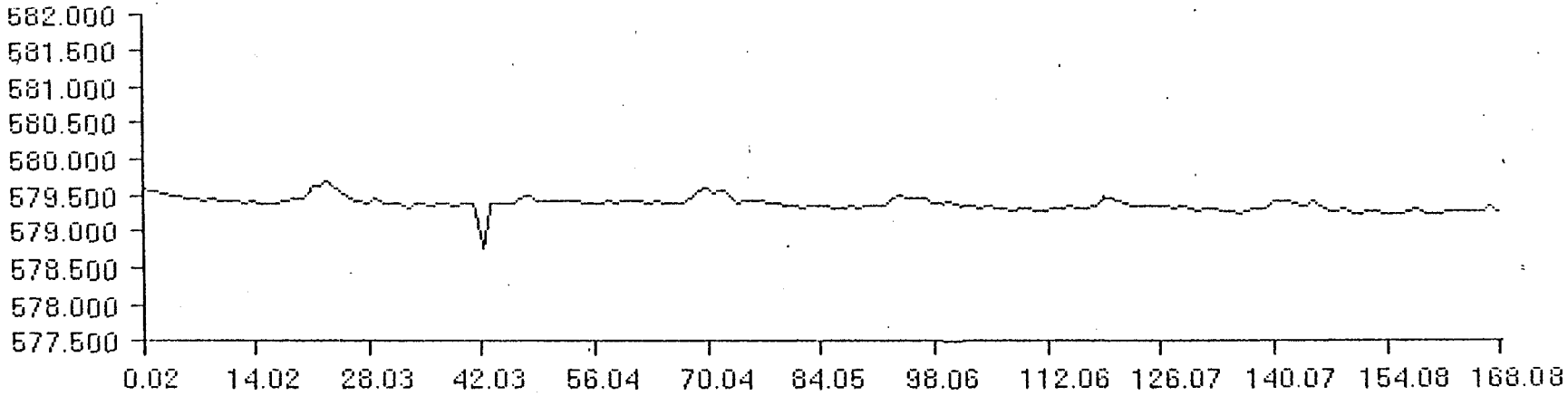
VS 7/23/1992 13:14: 1 1FKASOH4.S01

<S=SCALE> <M=MARK POINTS> <P=PRINT>

INTERVAL = 1 HR

7/28/92
12:04

7/23/92 PURGE
REPLACE -INTERNAL FITTING



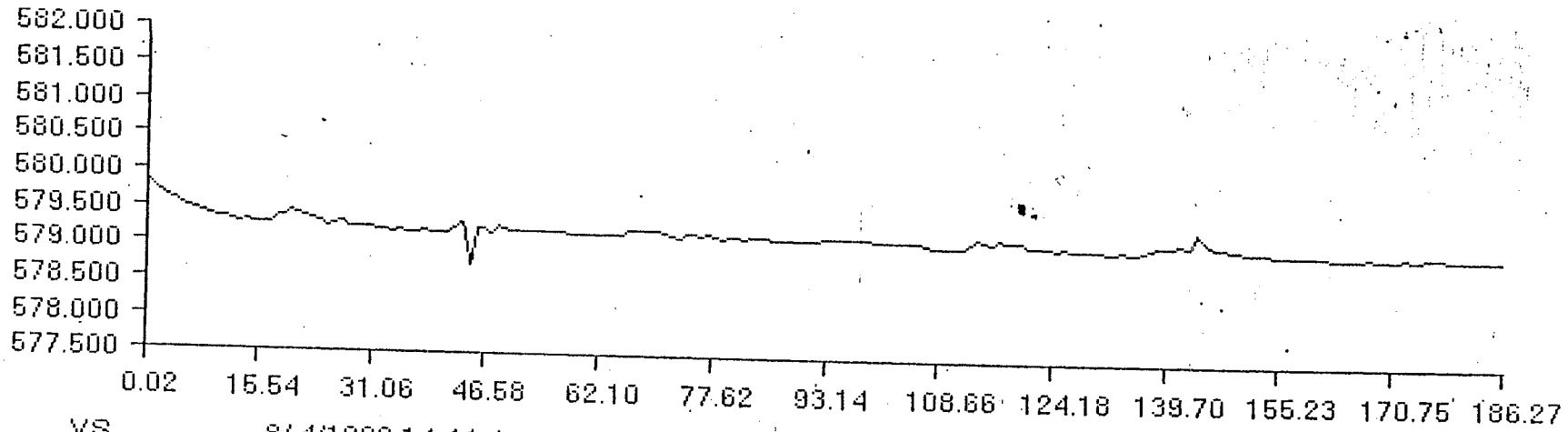
VS 7/28/1992 12:55: 1 1GKASOH4.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

INTERVAL = 1 HR

8/4/92
13:14

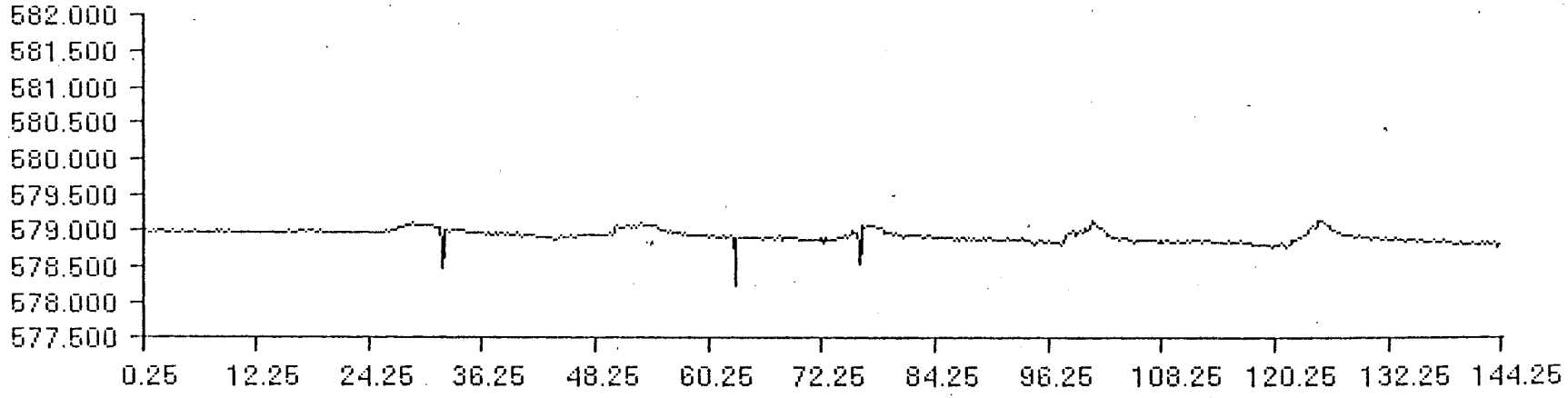
purge



VS 8/ 4/1992 14:44: 1
<S=SCALE> <M=MARK POINTS> <P=PRINT>

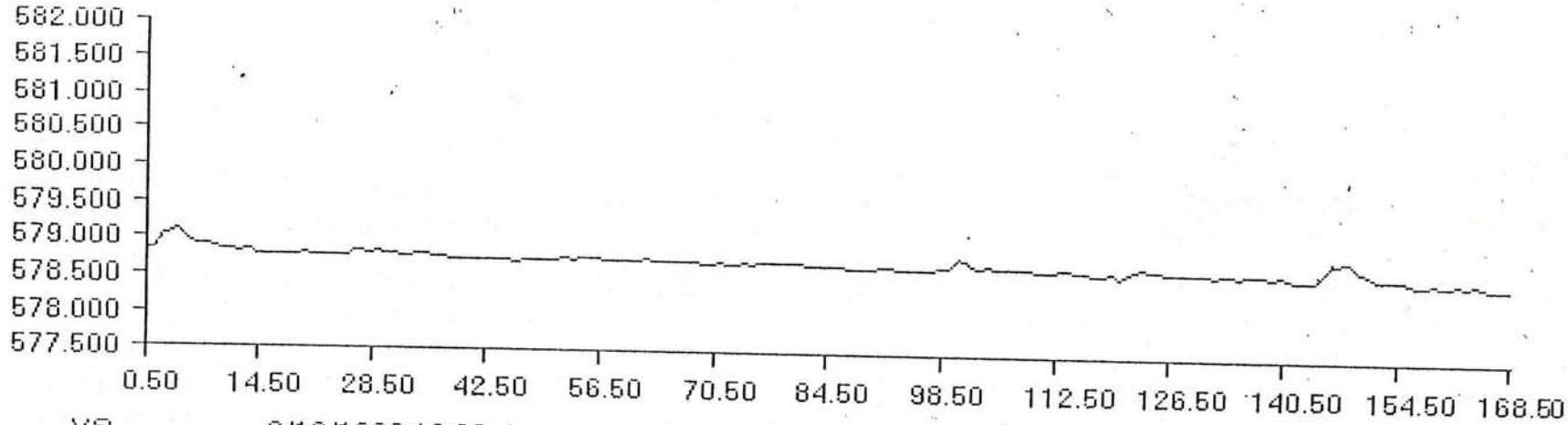
1HKASOH4.SUR 8/12/92
INTERVAL = 1 HR 9:58

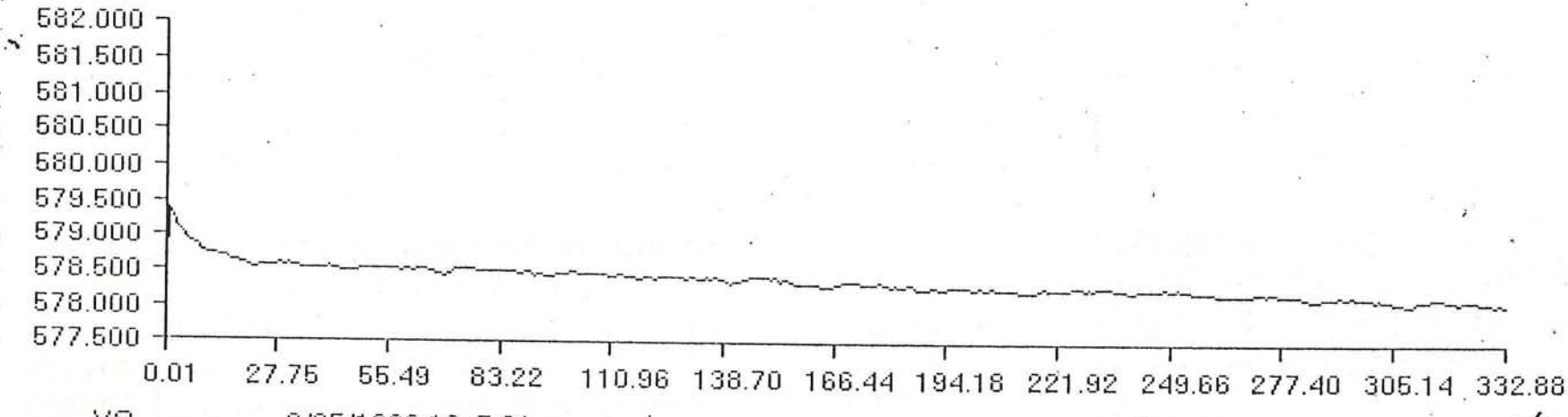
8/4/92 purge

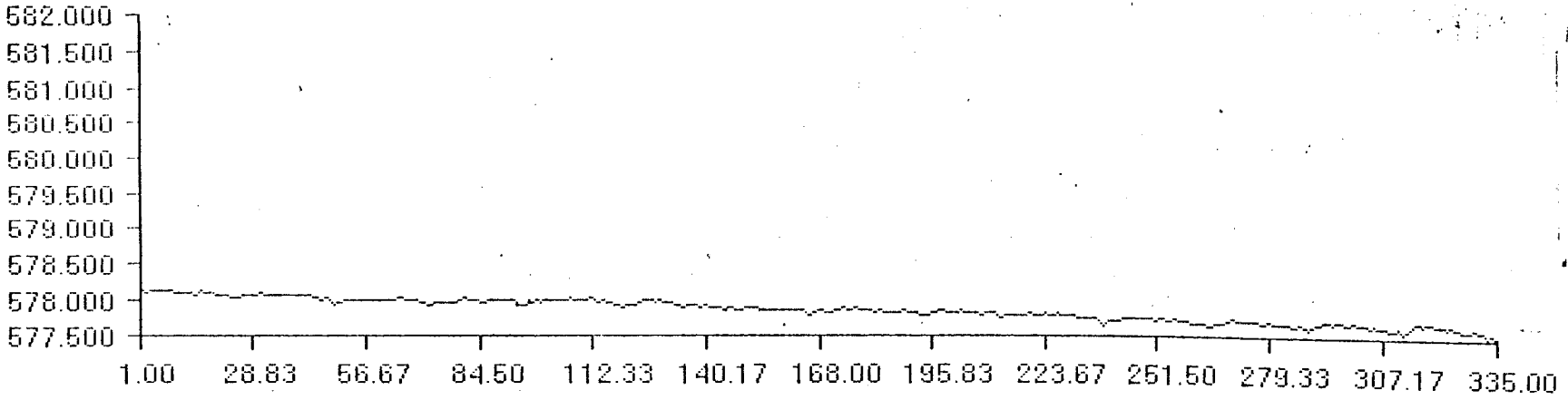


VS 8/12/1992 10: 0: 1
<S=SCALE> <M=MARK POINTS> <P=PRINT>

1IKASOH4.SUR 8/18/92
INTERVAL = 15 MIN 10:27


582.000
581.500
581.000
580.500
580.000
579.500
579.000
578.500
578.000
577.500
0.50
14.50
28.50
42.50
56.50
70.50
84.50
98.50
112.50
126.50
140.50
154.50
168.50
VS 8/18/1992 10:30: 1
<S=SCALE> <M=MARK POINTS> <P=PRINT>
1IKASOH4.S00
INTERVAL= 1HR
8/25/92
11:30

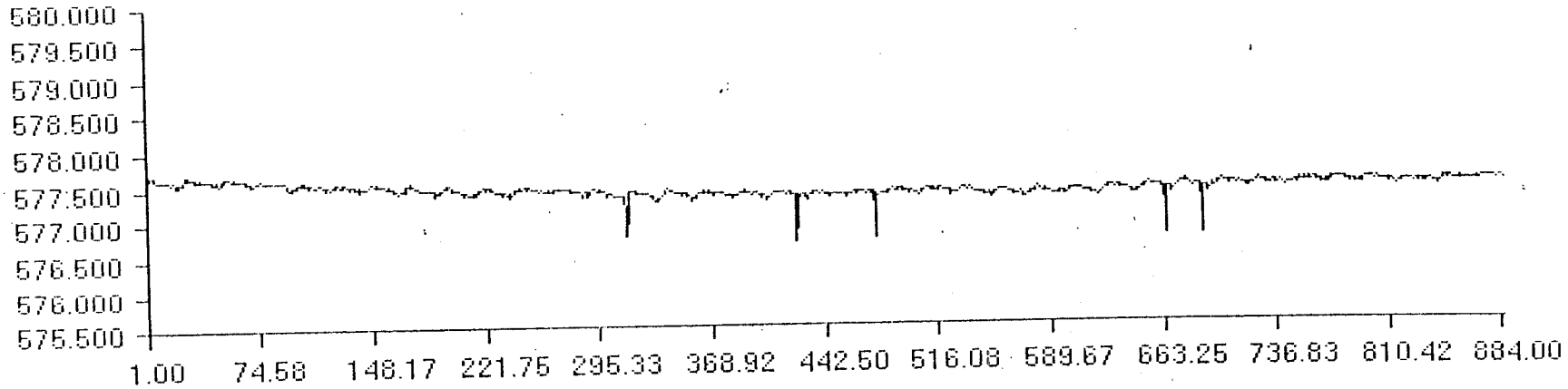

582.000
581.500
581.000
580.500
580.000
579.500
579.000
578.500
578.000
577.500
0.01
27.75
55.49
83.22
110.96
138.70
166.44
194.18
221.92
249.66
277.40
305.14
332.88
VS 8/25/1992 13: 7:31
<S=SCALE> <M=MARK POINTS> <P=PRINT>
1JKASOH4.SUR
INTERVAL= 1 HR
9/8/92
10:39



VS 9/ 8/1992 11: 0: 1
<S=SCALE> <M=MARK POINTS> <P=PRINT>

1KKASOH4.SUR
INTERVAL = 1 HR

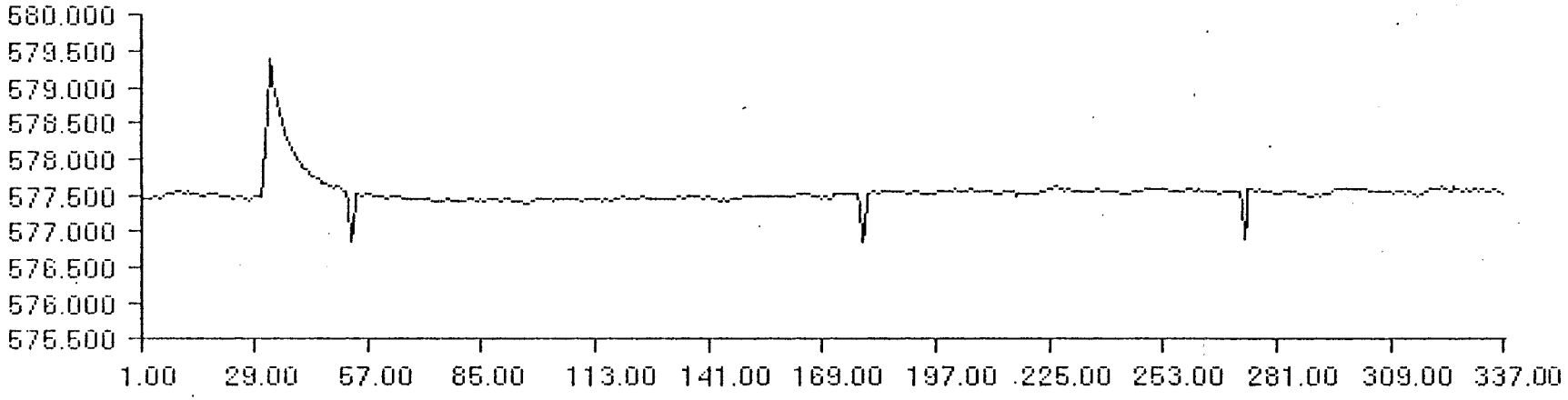
9/22/92
10:37



VS 9/22/1992 11: 0: 1
<S=SCALE> <M=MARK POINTS> <P=PRINT>

1LKASOH4.SUR
INTERVAL = 1 HR
37 DAYS

10/29/92
7:53



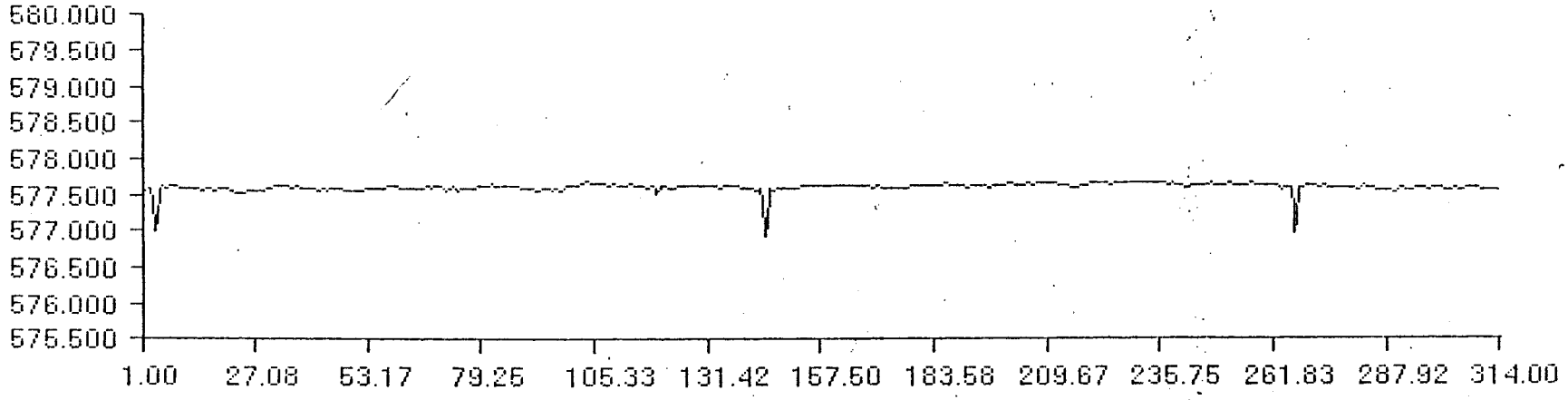
VS 10/29/1992 8:0:1 1MKASOH4.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

11/12/92
10:00

INTERVAL = 1 HR
14 DAYS

10/30/92
15:15
PURGE

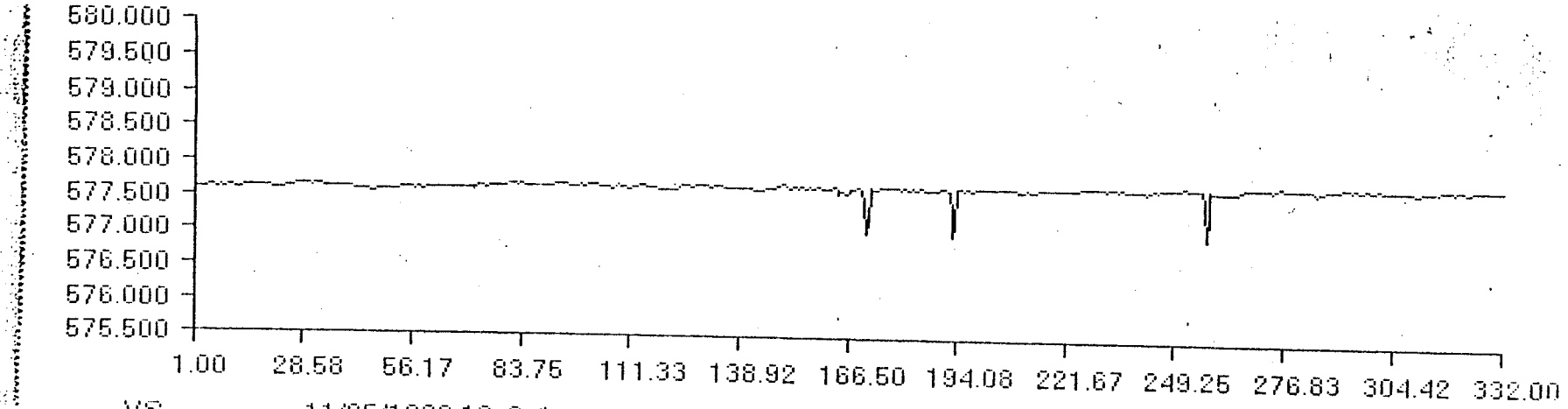


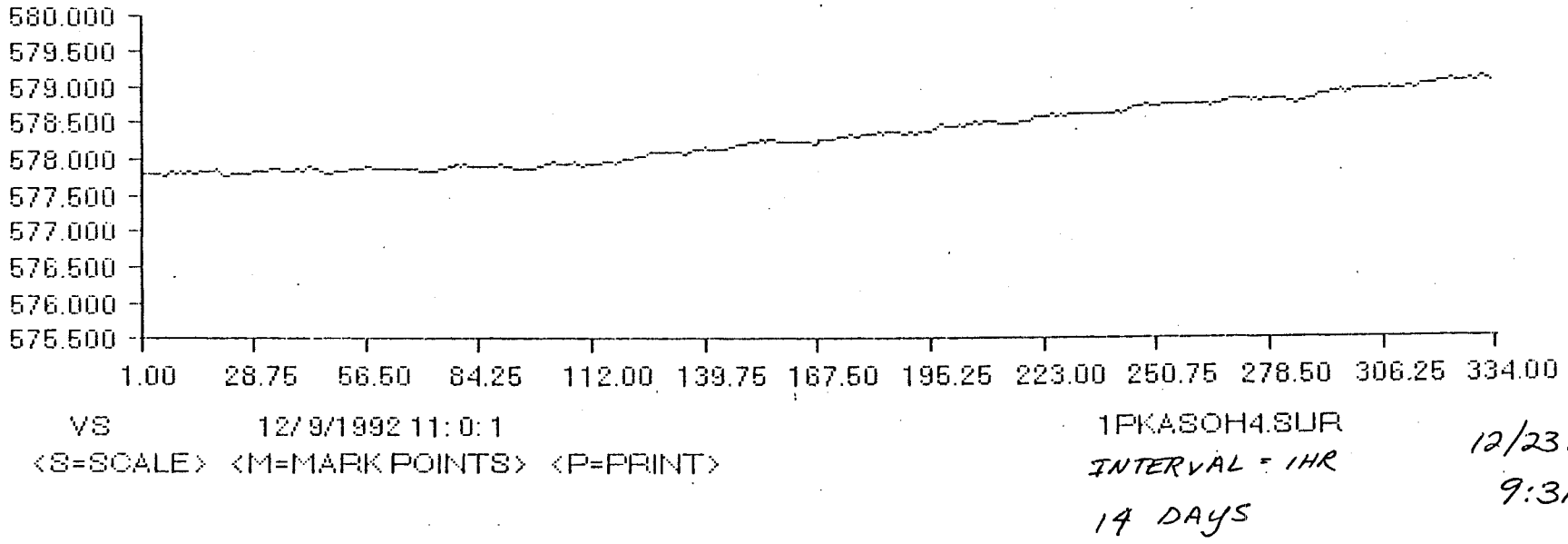
VS 11/12/1992 10:0:1 1NKASOH4.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

11/25/92
12:08

INTERVAL = 1HR
13 DAYS


580.000
579.500
579.000
578.500
578.000
577.500
577.000
576.500
576.000
575.500
1.00 28.58 56.17 83.75 111.33 138.92 166.50 194.08 221.67 249.25 276.83 304.42 332.00
VS 11/25/1992 13: 0: 1
<S=SCALE> <M=MARK POINTS> <P=PRINT>
1OKASOH4.SUR
INTERVAL = 1 HR
14 DAYS
12/9/92
9:54


580.000
579.500
579.000
578.500
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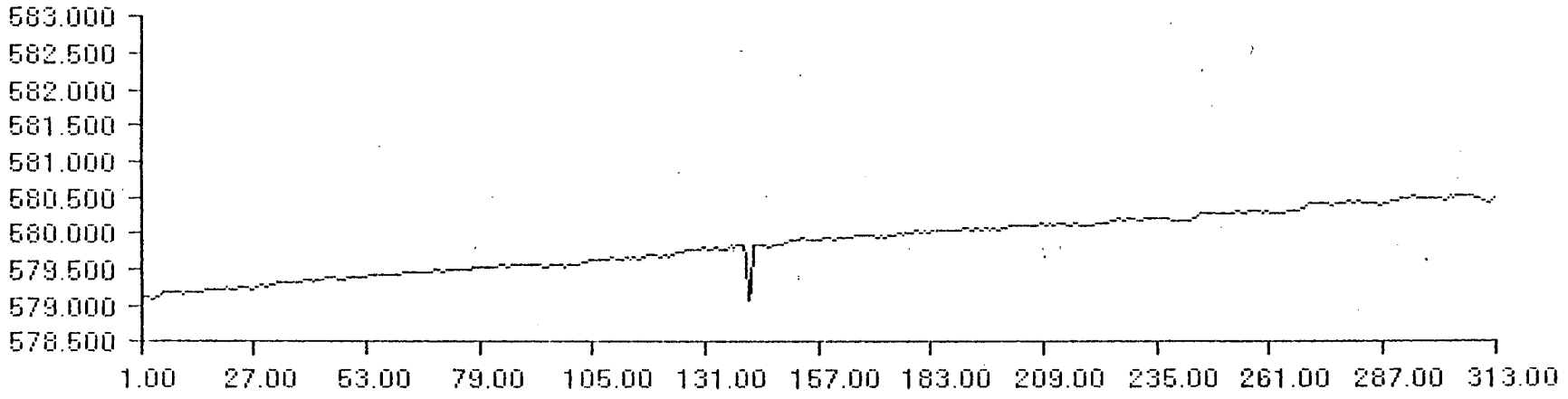
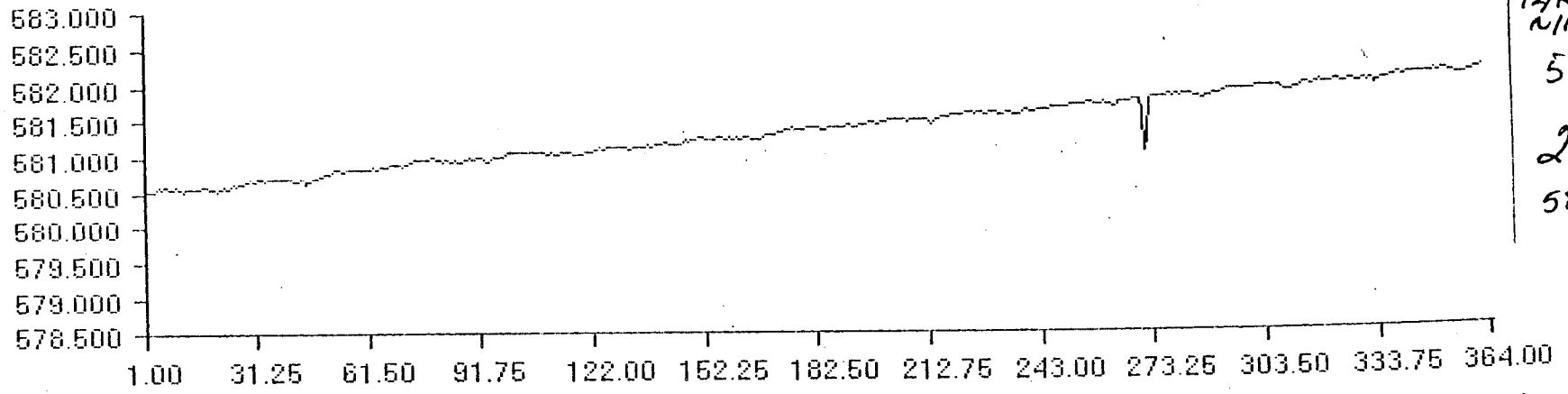
577.500
577.000
576.500
576.000
575.500
1.00 28.75 56.50 84.25 112.00 139.75 167.50 195.25 223.00 250.75 278.50 306.25 334.00
VS 12/ 9/1992 11: 0: 1
<S=SCALE> <M=MARK POINTS> <P=PRINT>
1PKASOH4.SUR
INTERVAL = 1HR
14 DAYS
12/23/92
9:31



VS 12/23/1992 10: 0: 1
<S=SCALE> <M=MARK POINTS> <P=PRINT>

1QKASOH4.SUR
INTERVAL = 1HR
13 DAYS

1/5/93
11: 14

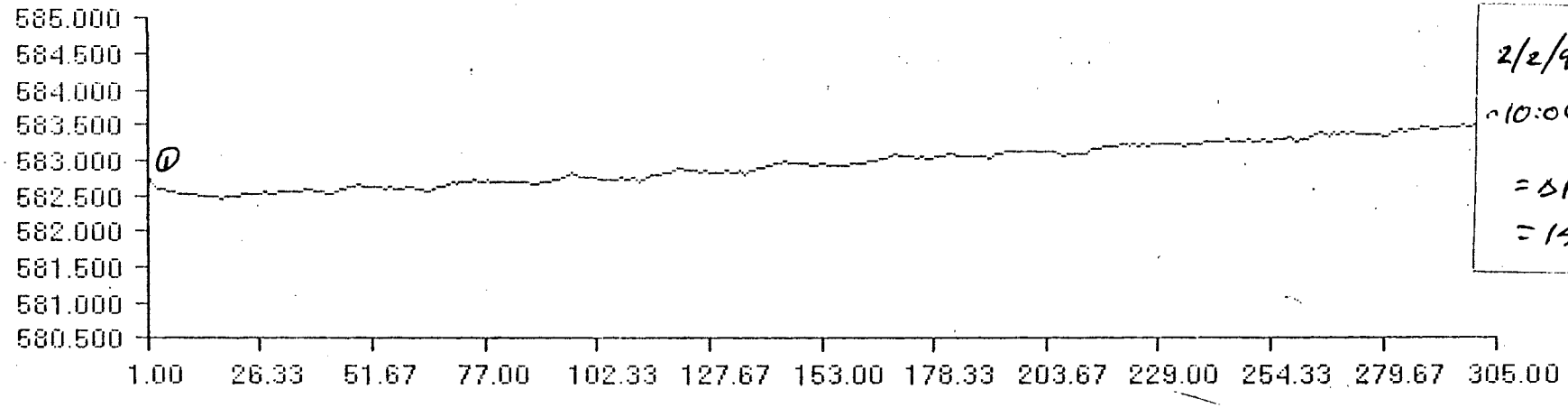


VS 1/5/1993 12: 0: 1
<S=SCALE> <M=MARK POINTS> <P=PRINT>

1RKASOH4.SUR
INTERVAL = 1 HR
15 DAYS

1/20/93
16:59

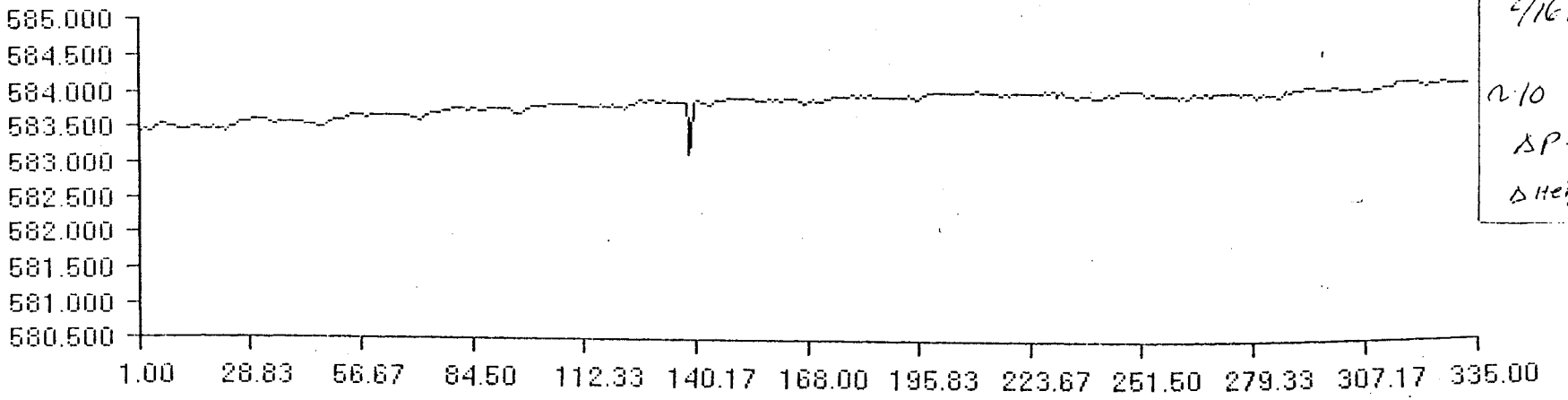
12/14/92 3 am 1/5/9
~1/2 hrs
577.7 - 580.
2.8# ~ 7
582 - 577.7 = 4.
= 10.75



2/2/93
~10:00 583.406
max 583.5 #
= ΔP = 5.8 #
= 14.5'

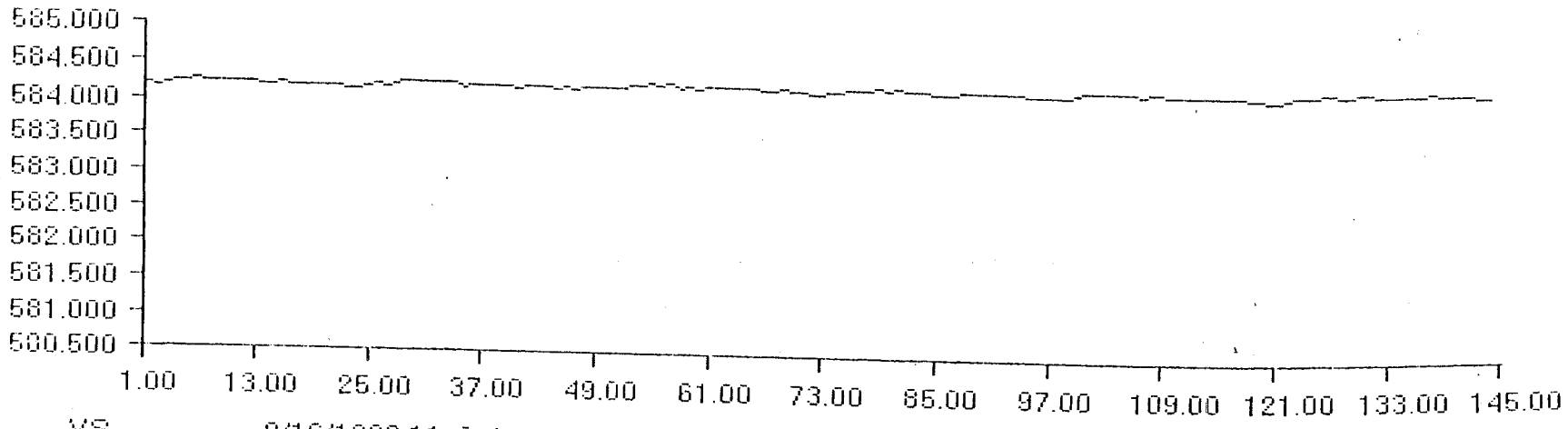
2/2/93
10:51

① PURGE
1/20/93
17:14 - 17:17



2/16/93
~10 584.1#
ΔP = 6.4#
Δ Height = 16'

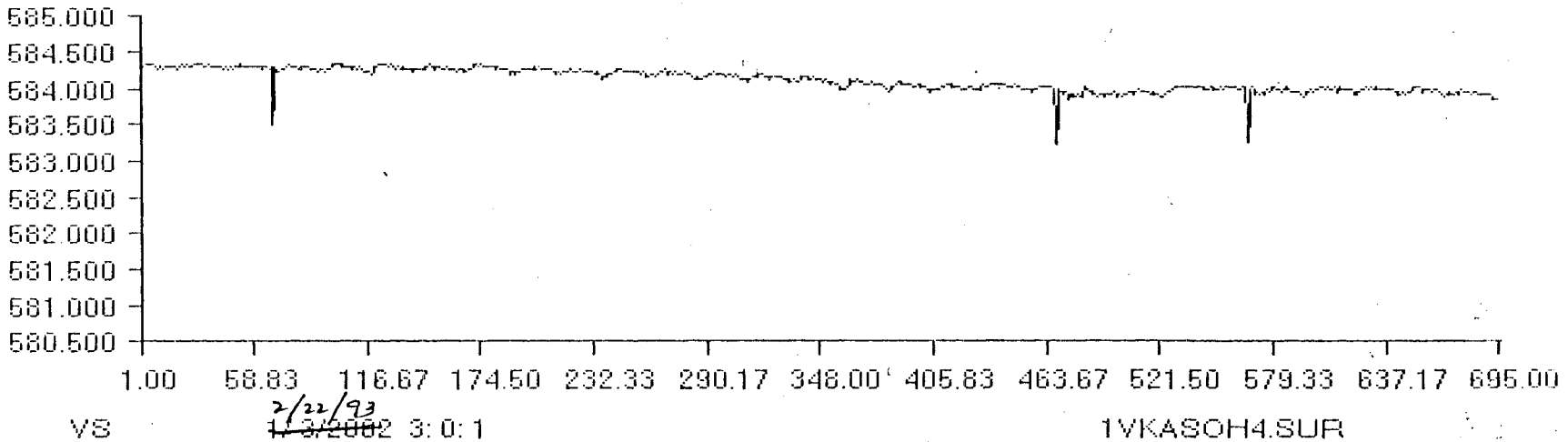
2/16/93
10:09



2/22/93

INTERVAL = 1 HR

6 DAYS

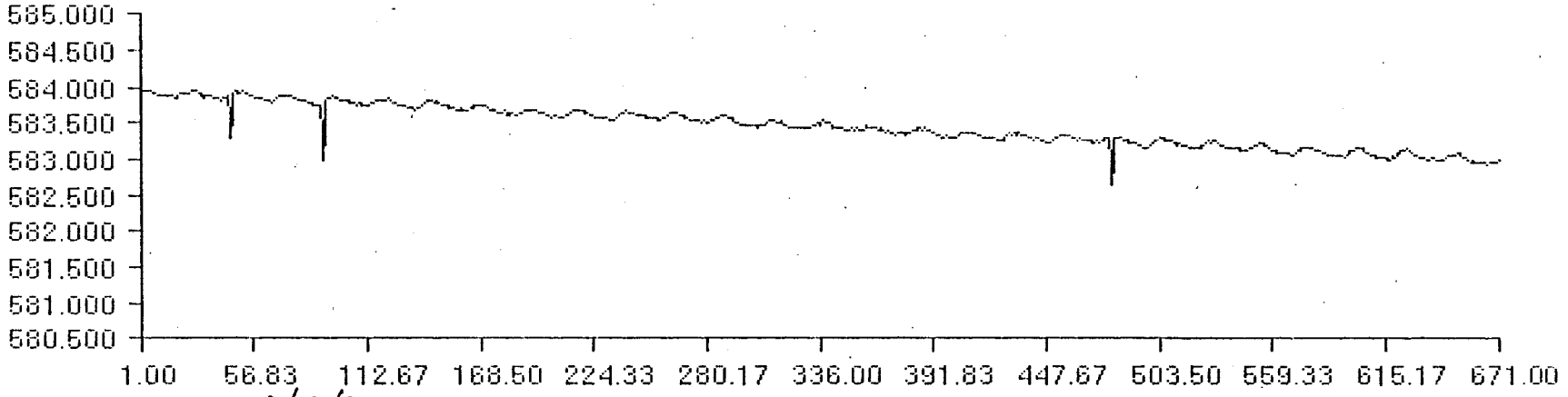


Interval = 1 hr

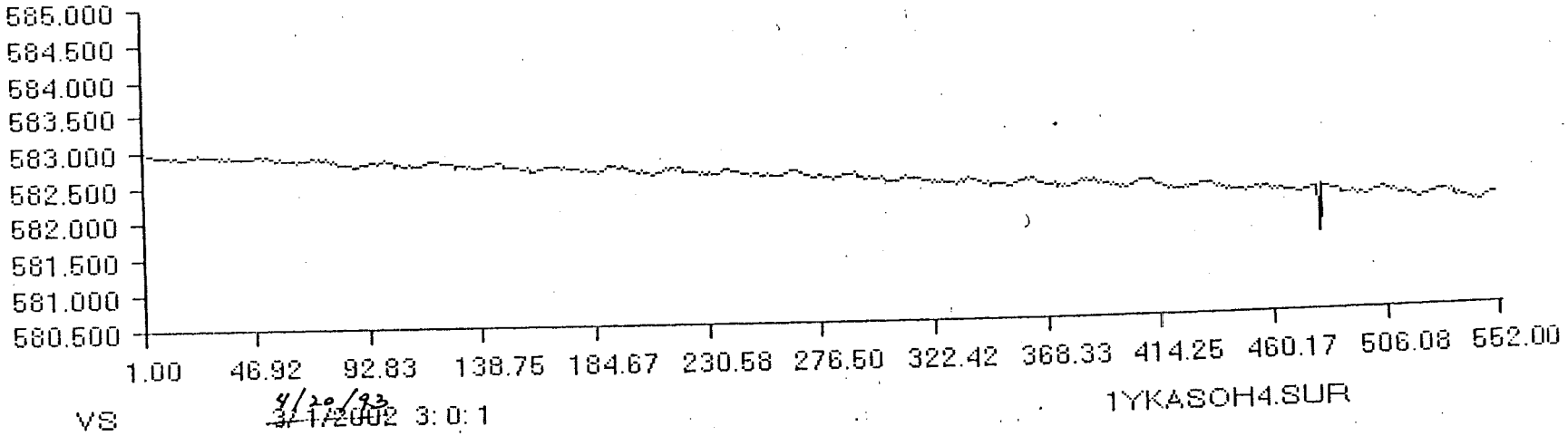
29 days

3/23/93

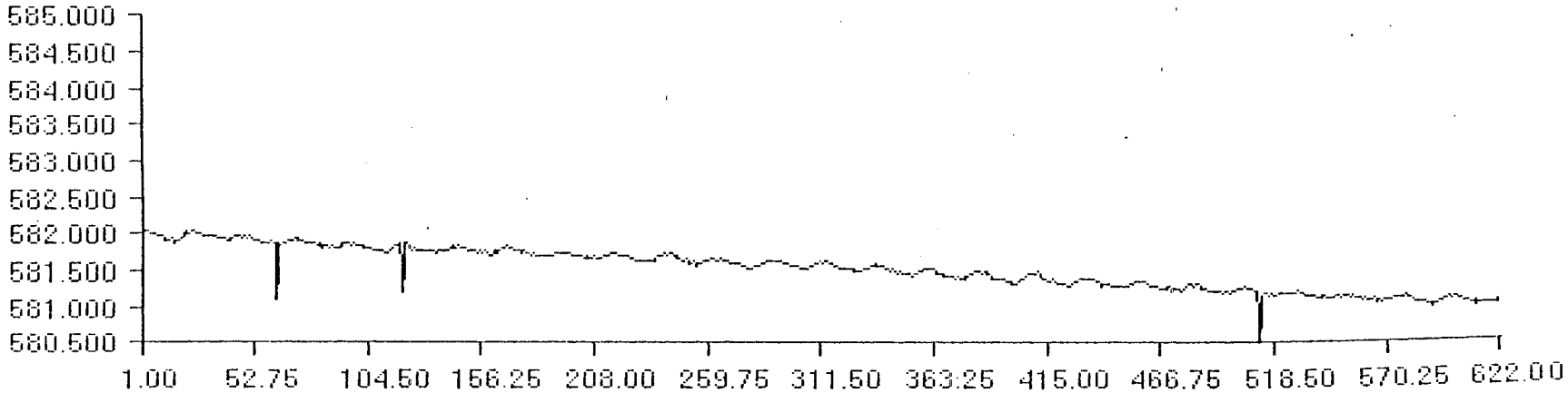
12:45 hours



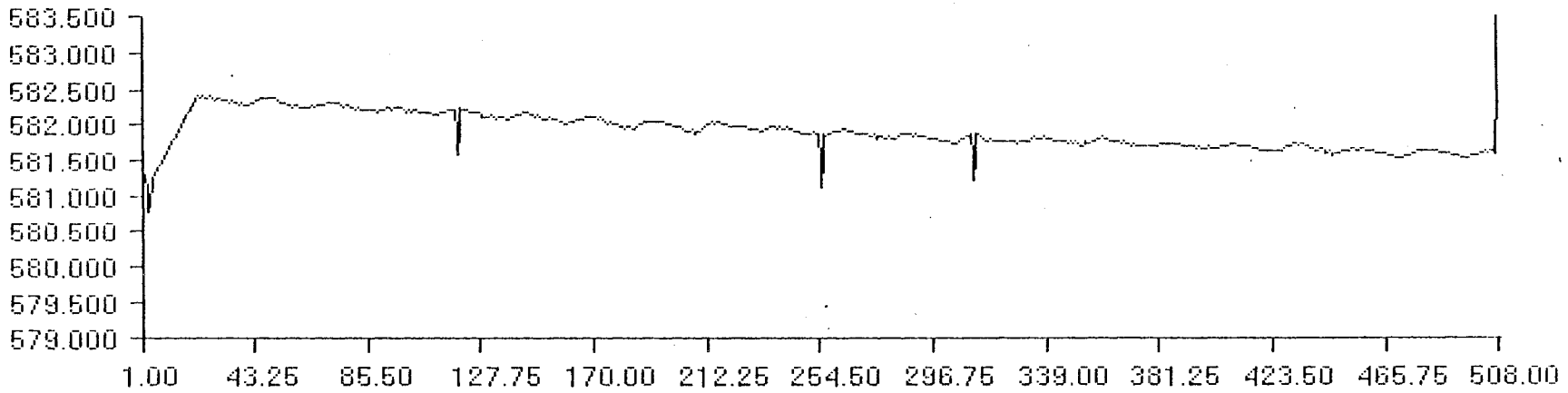
Interval= 1 hr.
28 days
4/20/93



Interval= 1 hr.
23 days
5/13/93



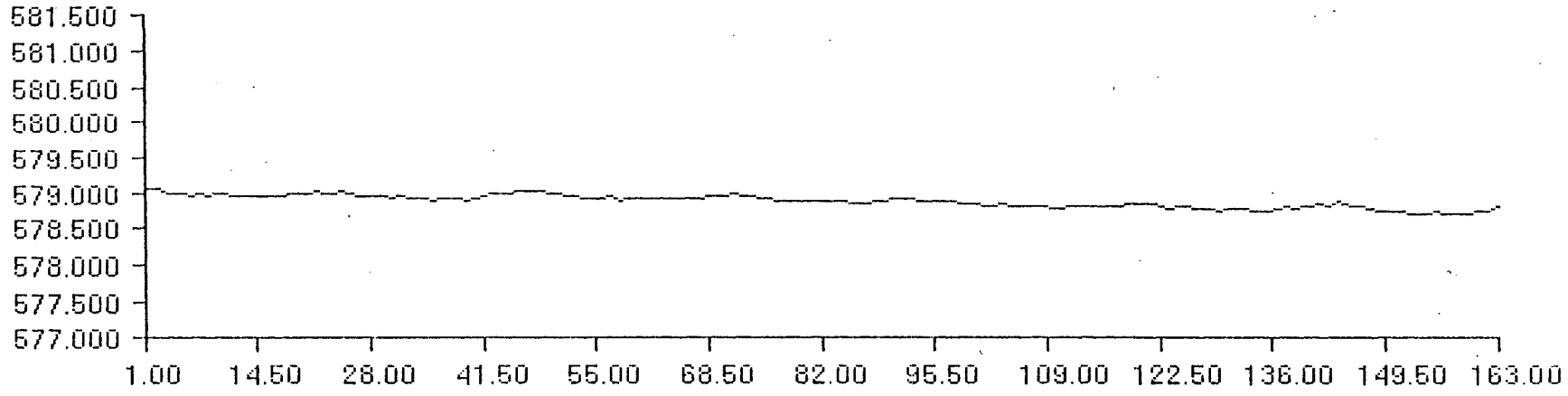
Interval = 1 hr.
26 days
6/8/93 12:00



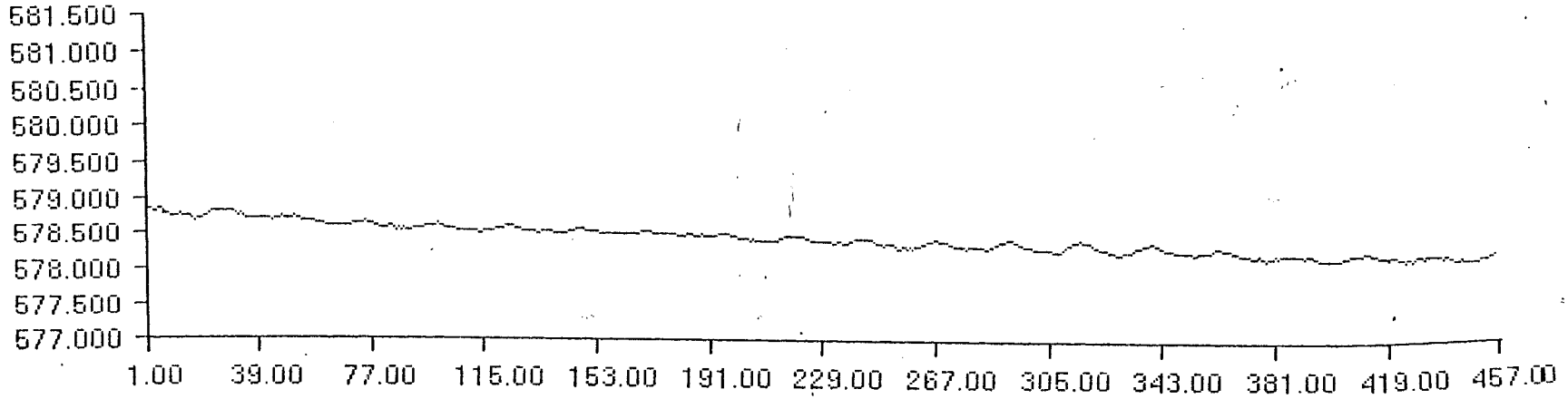
7/14/93
1125 hrs

Interval = 1 hour
15 days (?)

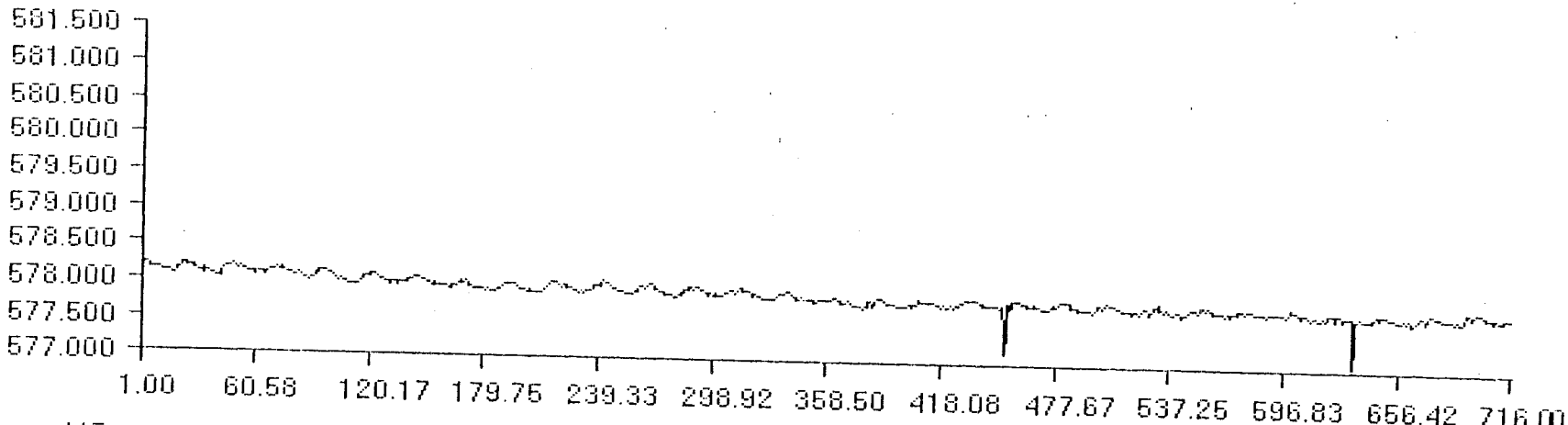
Note - Datalogger could not be downloaded because battery was discharged. Removed board from bottom half of solar charger. Battery



Interval = 1 hr
8/6/93
7 days
12:15



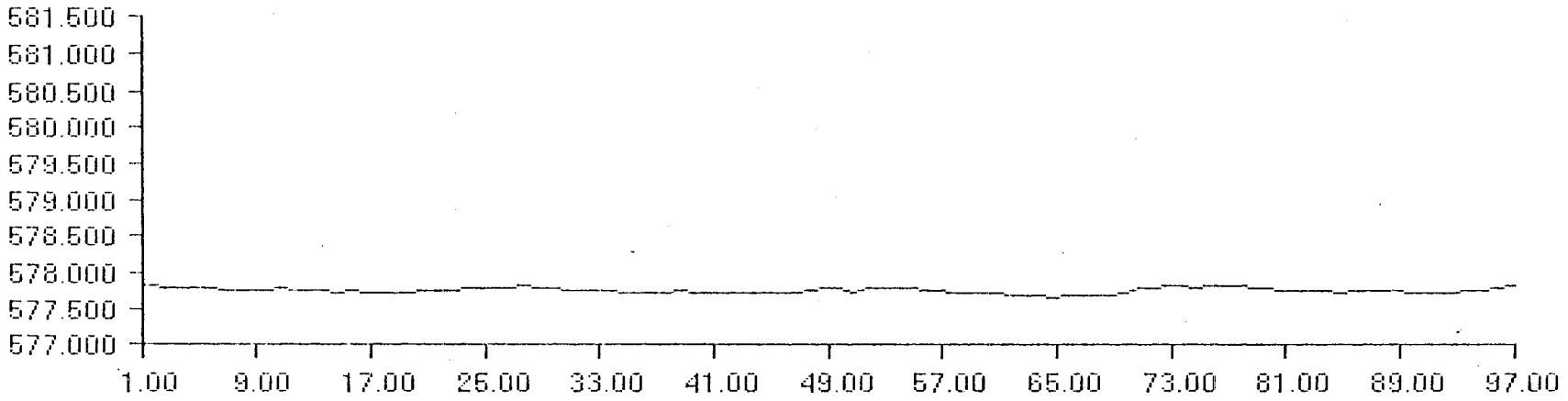
Interval = 1 hr.
8/25/93
19 days
12:40



VS 8/25/1993 14: 0: 1 1GKASOH4.SUR

<S=SCALE> <M=MARK POINTS> <P=PRINT>

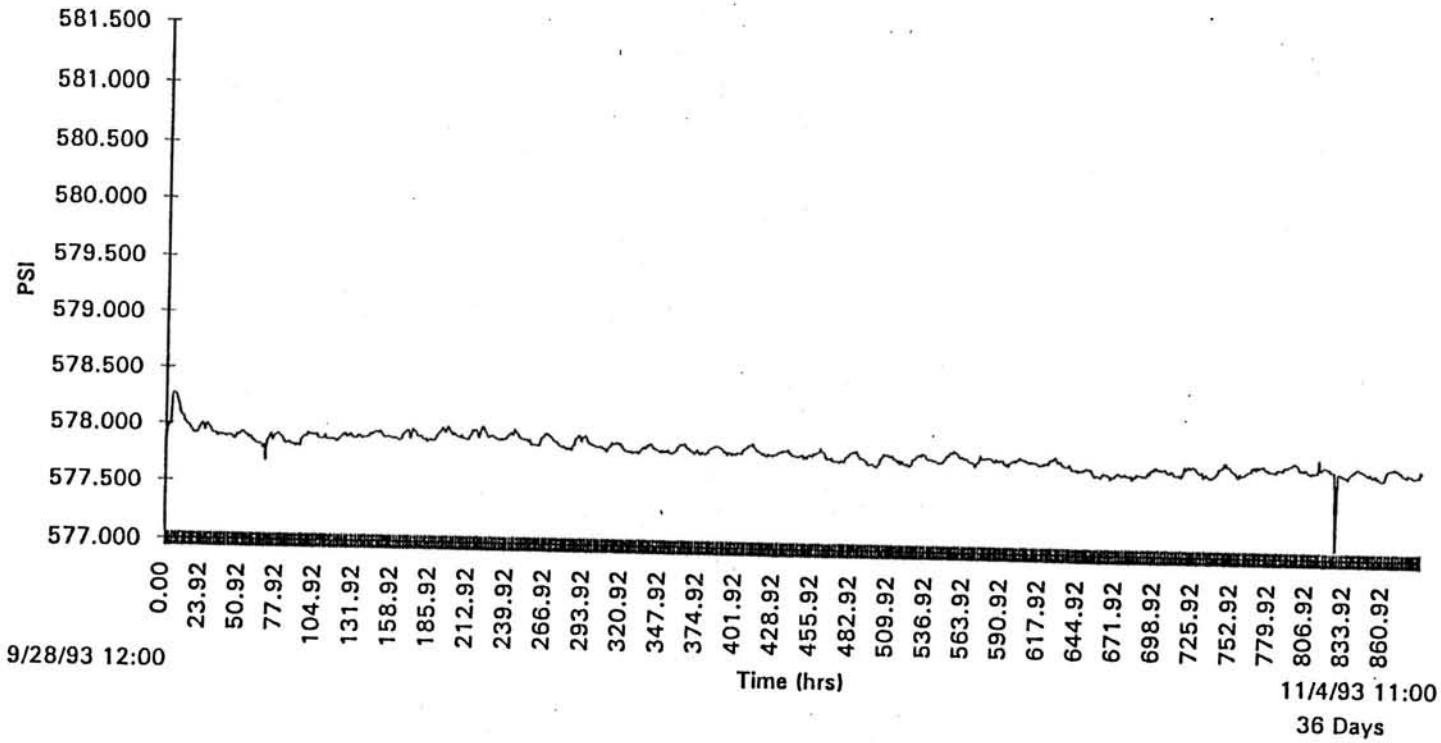
Interval = 1 hr
30 days
9/24/93
10:02

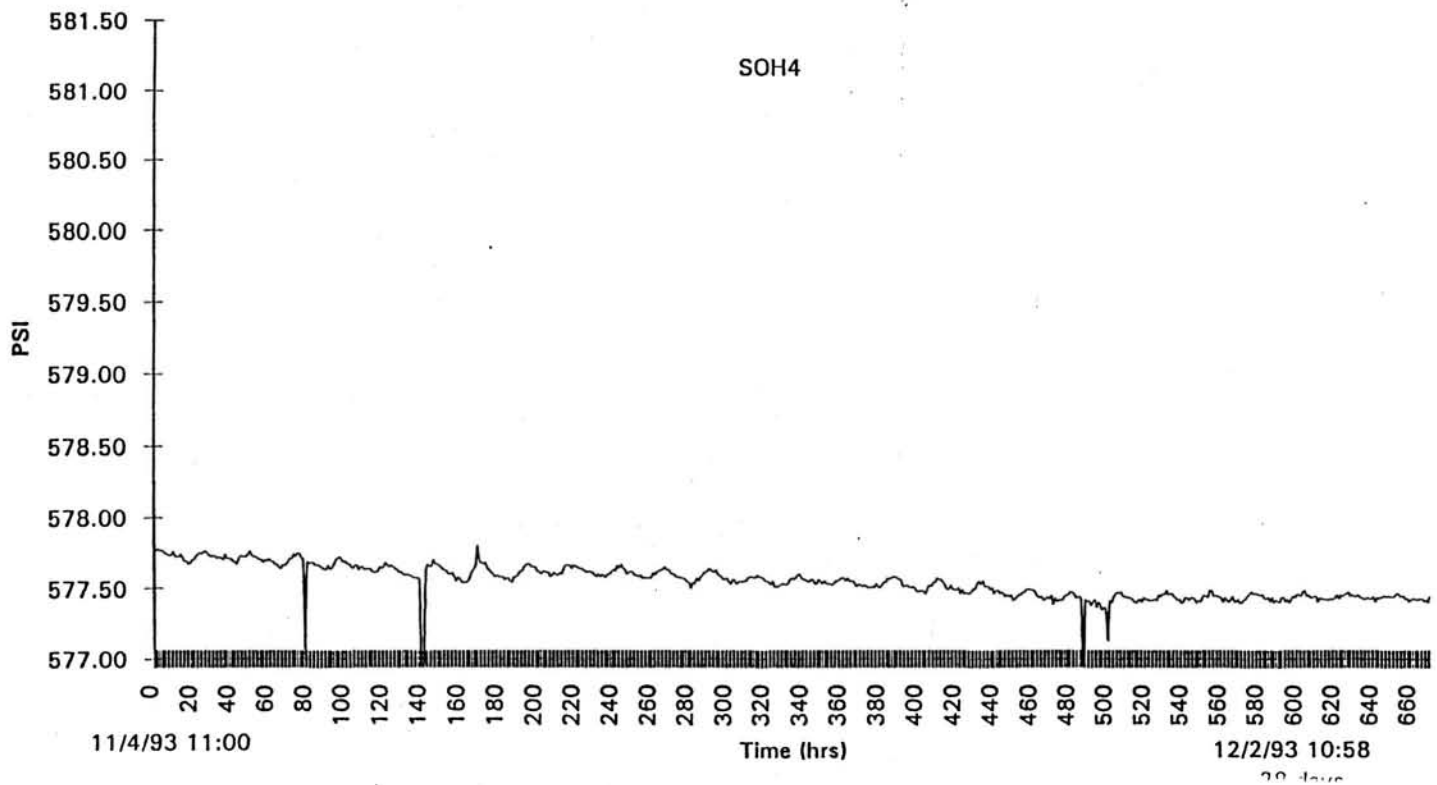


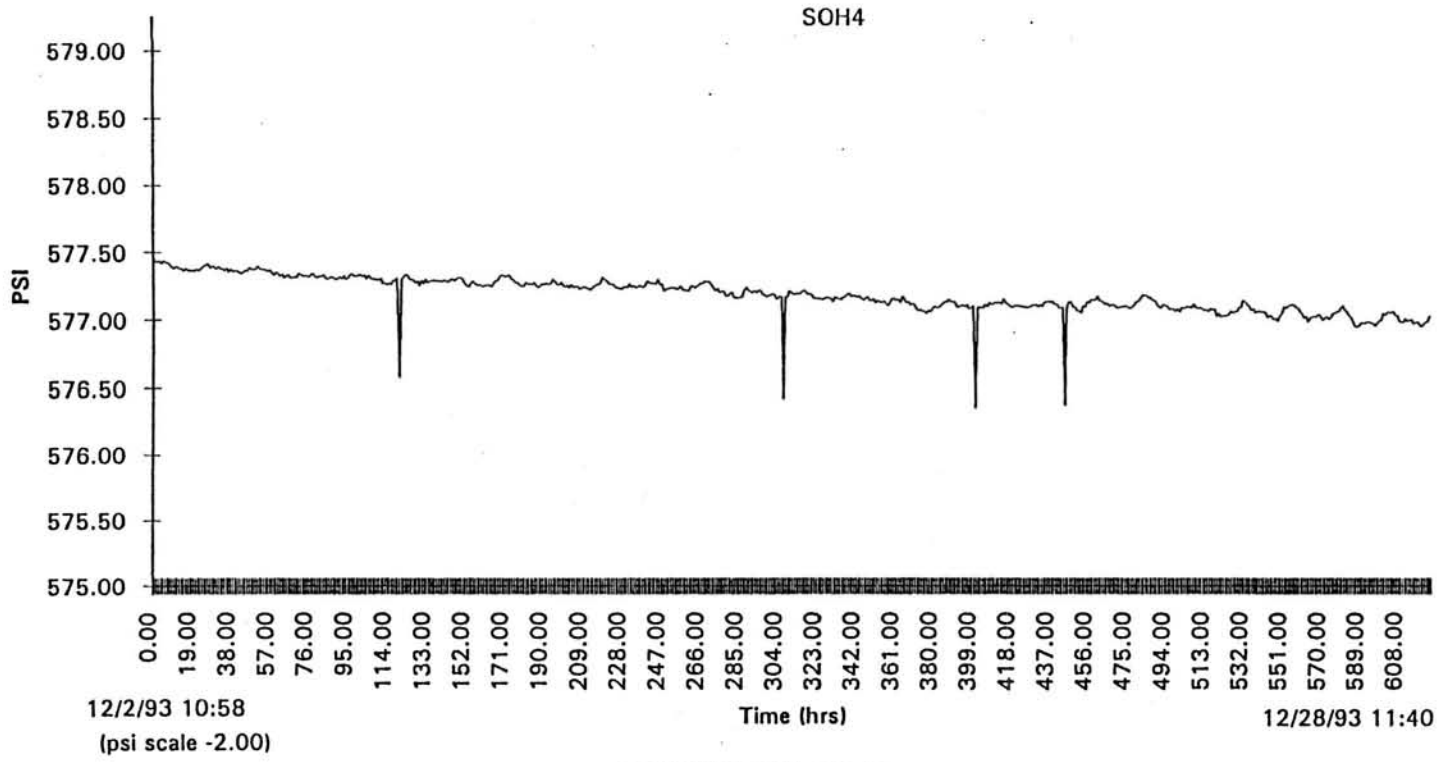
VS 9/24/1993 11: 0: 1 1HKASOH4.SUR

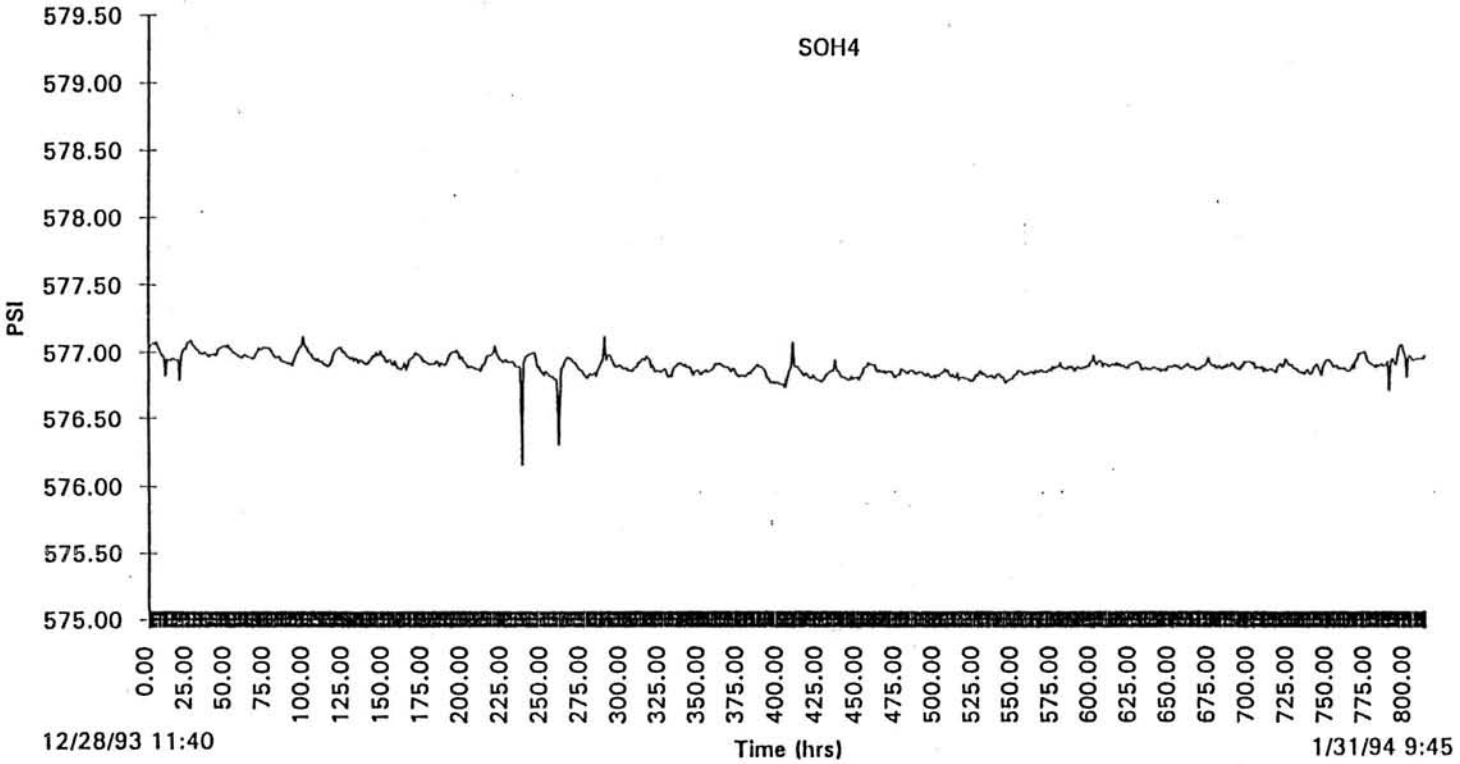
<S=SCALE> <M=MARK POINTS> <P=PRINT>

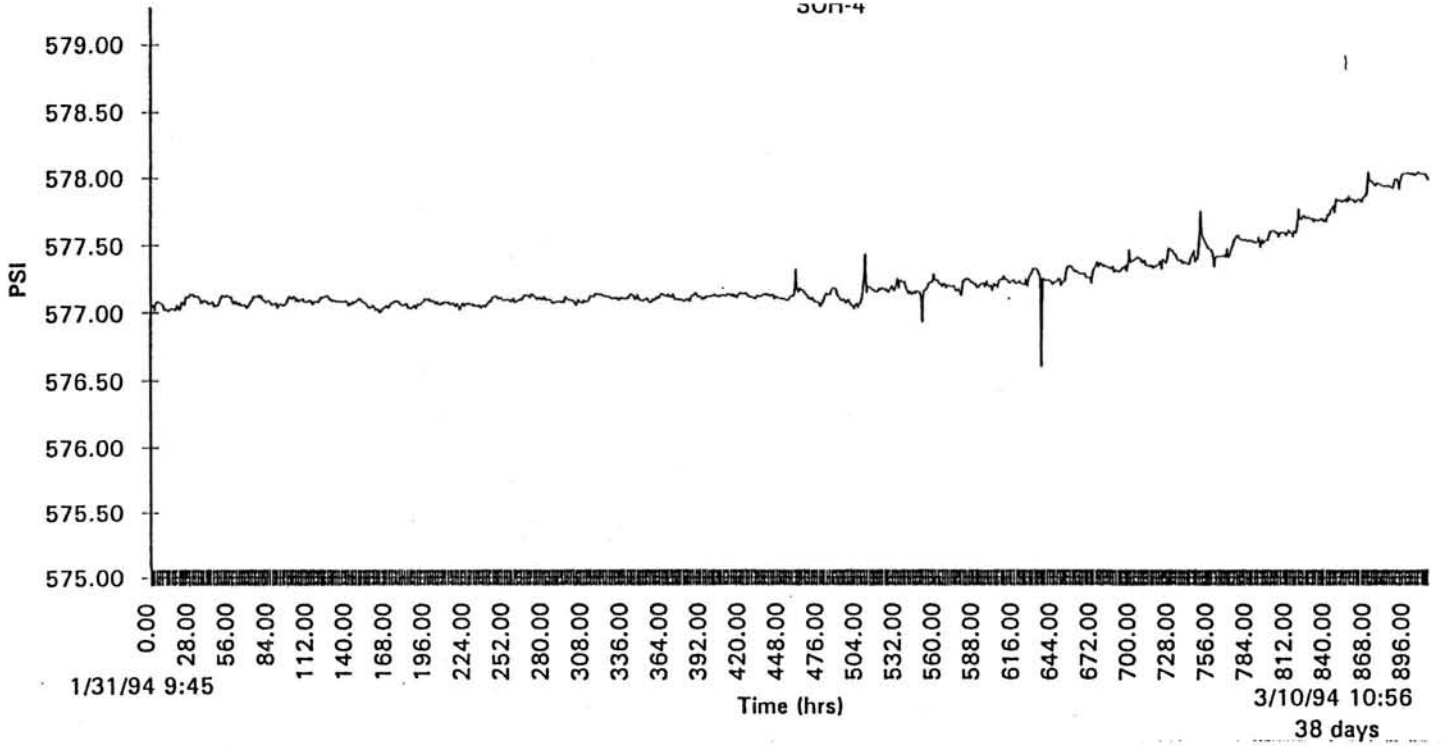
Interval = 1hr.
3 days
9/28/93 12:50

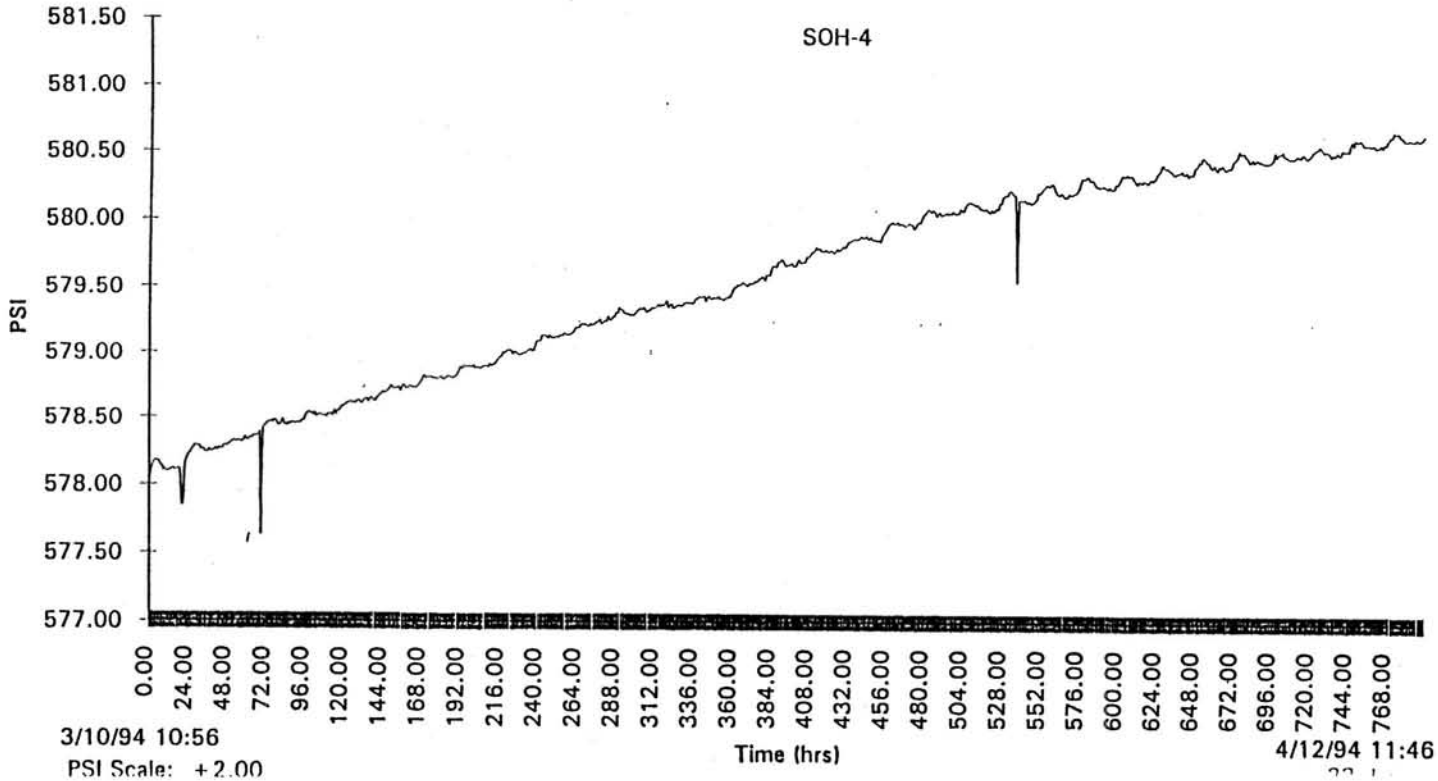

581.500
581.000
580.500
580.000
579.500
579.000
578.500
578.000
577.500
577.000
PSI
0.00
23.92
50.92
77.92
104.92
131.92
158.92
185.92
212.92
239.92
266.92
293.92
320.92
347.92
374.92
401.92
428.92
455.92
482.92
509.92
536.92
563.92
590.92
617.92
644.92
671.92
698.92
725.92
752.92
779.92
806.92
833.92
860.92
9/28/93 12:00
Time (hrs)
11/4/93 11:00
36 Days

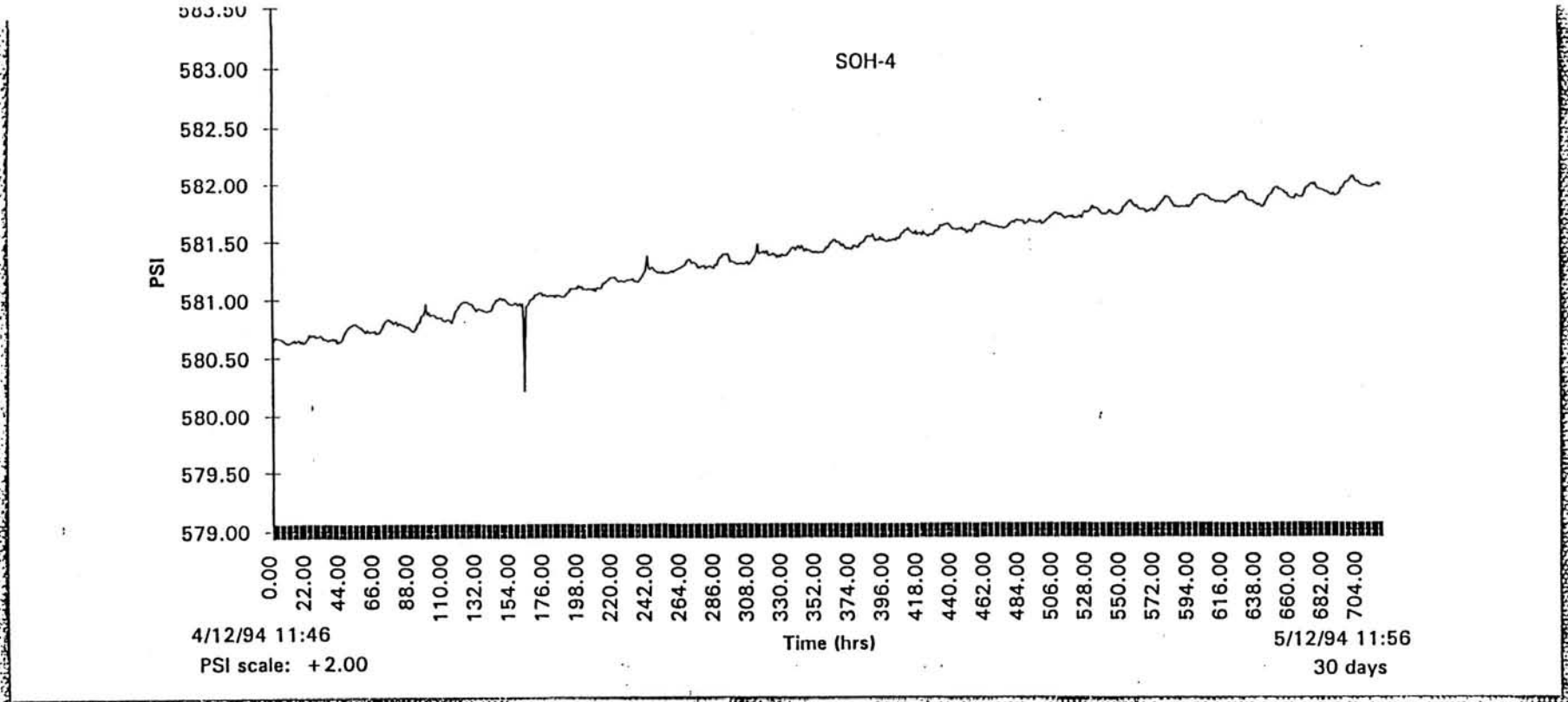

SOH4
581.50
581.00
580.50
580.00
579.50
579.00
578.50
578.00
577.50
577.00
PSI
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
460
480
500
520
540
560
580
600
620
640
660
11/4/93 11:00
Time (hrs)
12/2/93 10:58

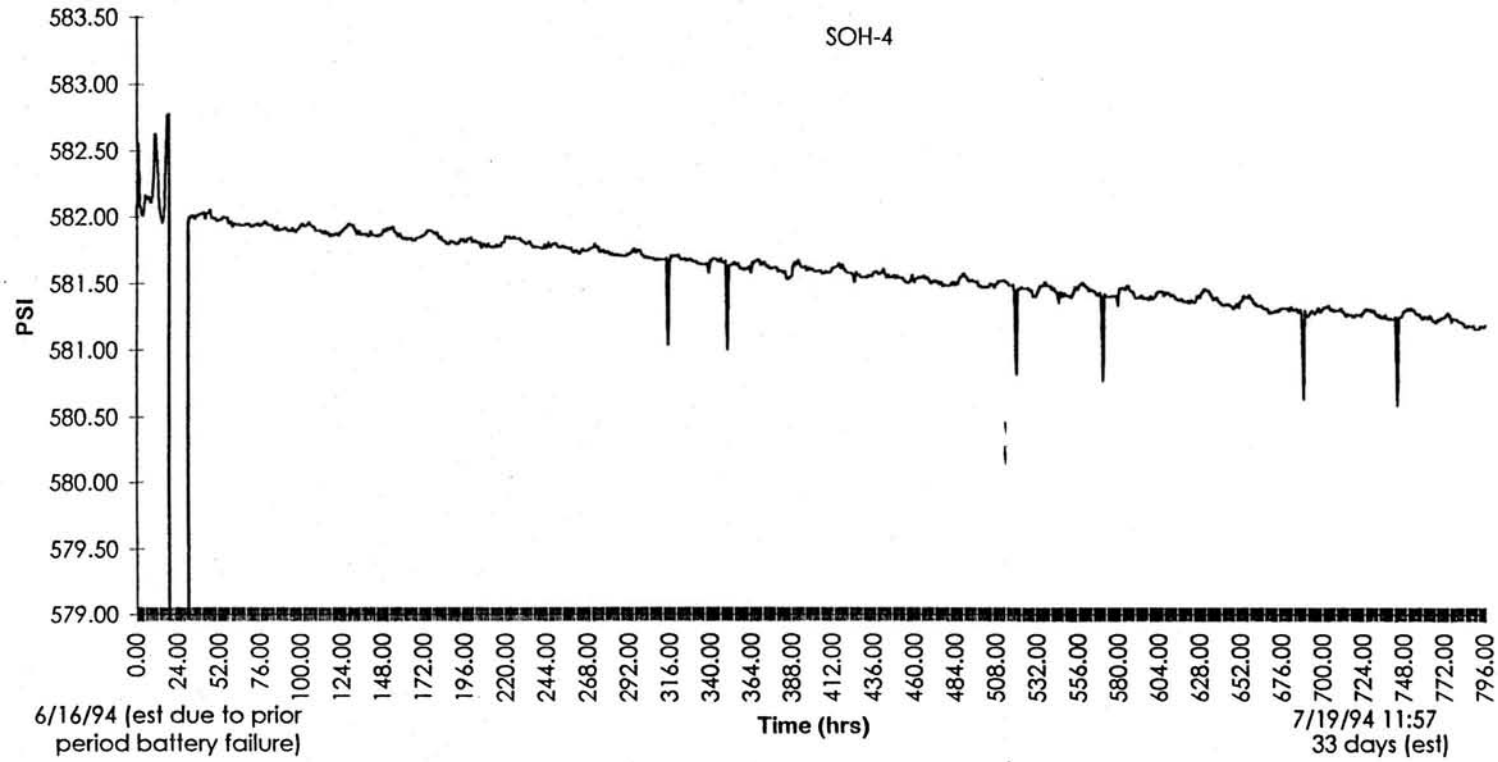

SOH4
PSI
579.00
578.50
578.00
577.50
577.00
576.50
576.00
575.50
575.00
0.00
19.00
38.00
57.00
76.00
95.00
114.00
133.00
152.00
171.00
190.00
209.00
228.00
247.00
266.00
285.00
304.00
323.00
342.00
361.00
380.00
399.00
418.00
437.00
456.00
475.00
494.00
513.00
532.00
551.00
570.00
589.00
608.00
12/2/93 10:58
(psi scale -2.00)
Time (hrs)
12/28/93 11:40


SOH4
PSI
579.50
579.00
578.50
578.00
577.50
577.00
576.50
576.00
575.50
575.00
0.00
25.00
50.00
75.00
100.00
125.00
150.00
175.00
200.00
225.00
250.00
275.00
300.00
325.00
350.00
375.00
400.00
425.00
450.00
475.00
500.00
525.00
550.00
575.00
600.00
625.00
650.00
675.00
700.00
725.00
750.00
775.00
800.00
12/28/93 11:40
Time (hrs)
1/31/94 9:45


SOH-4
PSI
579.00
578.50
578.00
577.50
577.00
576.50
576.00
575.50
575.00
0.00
28.00
56.00
84.00
112.00
140.00
168.00
196.00
224.00
252.00
280.00
308.00
336.00
364.00
392.00
420.00
448.00
476.00
504.00
532.00
560.00
588.00
616.00
644.00
672.00
700.00
728.00
756.00
784.00
812.00
840.00
868.00
896.00
1/31/94 9:45
Time (hrs)
3/10/94 10:56
38 days


SOH-4
PSI
581.50
581.00
580.50
580.00
579.50
579.00
578.50
578.00
577.50
577.00
0.00
24.00
48.00
72.00
96.00
120.00
144.00
168.00
192.00
216.00
240.00
264.00
288.00
312.00
336.00
360.00
384.00
408.00
432.00
456.00
480.00
504.00
528.00
552.00
576.00
600.00
624.00
648.00
672.00
696.00
720.00
744.00
768.00
3/10/94 10:56
PSI Scale: +2.00
Time (hrs)
4/12/94 11:46


SOH-4
583.00
582.50
582.00
581.50
581.00
580.50
580.00
579.50
579.00
PSI
0.00
22.00
44.00
66.00
88.00
110.00
132.00
154.00
176.00
198.00
220.00
242.00
264.00
286.00
308.00
330.00
352.00
374.00
396.00
418.00
440.00
462.00
484.00
506.00
528.00
550.00
572.00
594.00
616.00
638.00
660.00
682.00
704.00
4/12/94 11:46
Time (hrs)
5/12/94 11:56
PSI scale: +2.00
30 days


SOH-4
583.50
583.00
582.50
582.00
581.50
581.00
580.50
580.00
579.50
579.00
PSI
0.00
24.00
52.00
76.00
100.00
124.00
148.00
172.00
196.00
220.00
244.00
268.00
292.00
316.00
340.00
364.00
388.00
412.00
436.00
460.00
484.00
508.00
532.00
556.00
580.00
604.00
628.00
652.00
676.00
700.00
724.00
748.00
772.00
796.00
Time (hrs)
6/16/94 (est due to prior period battery failure)
7/19/94 11:57
33 days (est)

APPENDIX III-A

Pruett Mini Max Datalogger

Download Instructions: Pressure Data

PRUETT MINI-MAX DATALOGGER
Download Instructions: Pressure Data

1. Run program.
   At opening menu, select option 1.
   At prompt, change directory as appropriate (below). [eg, cd\mm8-1 ENTER]

   The program files are located in directories as follows:

SOH-1	directory name: MM8-1
SOH-2	directory name: MM8-2
SOH-4	directory name: MM8-4
HGP-A	directory name: MM8-H

   At prompt, type MM8. Press ENTER.

   From Main Menu, select item:

   #1 Change Port Settings. Press ENTER.
   At Port Menu, select #1 Pressure 1. Press ENTER.
   At next screen, change "Run Number," eg, 1A to 1B. Press CTRL-ENTER.
   Press ESC to return to Main Menu.

   #4 Down Load Last Data. Press ENTER.
   Screen prompt, "Press a key to continue..:" to return to Main Menu.

   #6 Convert File Format. Press ENTER.
   At Convert Menu, select #1 Pruett Format. Press ENTER.
   Program will read data lines then display "Conversion Complete. Press a key to continue..."
   Next screen will display "Enter file name to be converted: DATALOG.D_". Press ENTER.
   When complete, display will read "Do you wish to convert another file (Y/N):" Press N. Press ENTER.
   Next screen will display Convert Menu.

   Select #2 Lotus Format. Press ENTER.
   (Repeat prior steps.)

   Press ESC to return to Main Menu.

   #7 Exit Program. Press ENTER.

2. Verify that all files have been saved to hard drive.
   At prompt, type DIR. Press ENTER.
   Check for the following: PRUETT.C(# depends upon prior data file)
   DATALOG.D(_____")
   1 (run #)KA (hole).SUR

3. Check data; record data at beginning and ending of series.
   At prompt, type TYPE DATALOG.D(# per above). Press ENTER.
   Press CTRL-S to stop scrolling. Press ENTER to restart.

4. At next site, change directory as appropriate, type MM8, press ENTER. Repeat procedure.

PRUETT MINI-MAX DATALOGGER
Data Plot Instructions

To run plot program:

Insert program diskette in disk drive.
At **A:\>**, type MLOG. Press ENTER.
Select option View at Main Menu.
Next screen will show CURRENT DIRECTORY>. Press ENTER.
Last recorded 1_KA_____.SUR file name will appear.
Type file name at prompt at bottom of screen. Press ENTER.
File Control Menu will appear. Select "Plot Current File."
"Analyzing Data" message will appear.
Plot will appear. Press ENTER for Print and Scale options.
Type S. Set high and low data points at prompts. Press ENTER after each.
Type P to print plot. Press ESC to return to Main Menu.

Insert next diskette in disk drive. Select option View. Repeat steps above.

When done, select option Quit. Press ENTER.

Save Data to Data Diskettes

Procedure is applicable to SOH-1, 2, 4 and HGP-A well data. Example is provided for SOH-1.

1. At C drive, change to directory for SOH-1.

   C:\>**cd\mm8-1**

2. Insert backup diskette in A drive. Directories should have been created on diskette as follows:

SOH-1	directory name: MM8-1
SOH-2	directory name: MM8-2
SOH-4	directory name: MM8-4
HGP-A	directory name: MM8-H

3. Type copy command to copy Pruett and Datalog files to diskette. Both files have the same run number for copying reference.

   C:\mm8-1>**copy *.?(run number) a:\mm8-1*.***

   Eg., C:\mm8-1>copy *.?9 a:\mm8-1*.*

4. Type copy command to copy .SUR and .A1 files to diskette.

   C:\>**copy 1(run alpha)KA(hole name).* a:*.***

   Eg., C:\mm8-1>copy 1UKASOH1.* a:\mm8-1*.*

5. Verify 4 files have been properly copied to diskette using dir command.

   Change to A drive:

   C:\mm8-1>**a:** PRESS ENTER.

A:\>**cd\mm8-1** PRESS ENTER.

A:\mm8-1>**dir** PRESS ENTER. View files.

6. Return to C drive to copy data files for other SOHs to diskette.

A:\>**c:** PRESS ENTER.

Repeat steps 1-6 above.

APPENDIX III-B

Jack Tidwell Plot Manual for MS-1

PRUETT INDUSTRIES INTERNATIONAL

8915 ROSEDALE HWY • BAKERSFIELD, CA 93312 • 805/589-2768

TELEX 4992440 PRUETT INT
FAX 805/589-3268

University of Hawaii
Look Laboratory
811 Olomehani St.
Honolulu, Hawaii

November 4, 1993

Attn: Harry Olson

Dear Sir,

Enclosed are two (2) copies of the manual for the plot software for your MS-1 that Jack Tidwell wrote. If there are any question, please feel free to call.

Sincerely,

John Hoffman
Project Coordinator

PRUETT INDUSTRIES INTERNATIONAL

8915 ROSEDALE HWY • BAKERSFIELD, CA 93312 • 805/589-2768

TELEX 4992440 PRUETT INT
FAX 805/589-3268

STATUS BOX

The "STATUS" box, lets you know at a glance what parameters you have programmed into the software for printing/plotting or viewing on the display, survey files saved.

PLOTTER: Shows what type of printer/plotter has been selected to be used.

PAPER SIZE: Shows what size of paper has been selected for the files to be plotted/printed out on.

ORIENTATION: Shows what type of orientation has been selected, either "LANDSCAPE" or "PORTRAIT" for plotting out the survey.

SUB-TICS: Shows if you have selected "SUB-TICS", (1/10 inch graduation lines) will be displayed on the "X" and "Y" axis when plotting out the survey.

VIDEO PLOT: Shows if you have selected the survey to be plotted out on paper by a printer/plotter or displayed on the monitor. If "YES" is displayed, the plot will be displayed on the "MONITOR" only, and if "NO" is displayed, the survey can only be plotted out on a printer/plotter.

PRIMARY FILE: Shows the file name of the "PRIMARY FILE" selected to be plotted out or displayed on the monitor.

OVERLAY FILE: Shows the file name of the "OVERLAY FILE" that has been selected to be plotted out or viewed on the monitor.

COPIES: Indicates the number of copies that will be printed out on the printer/plotter when a file or survey is plotted out.

X START: This is the footage (depth-lowest number) that the plot will start at when you view the survey on the monitor or plot out the survey on a printer/plotter.

X UNITS/INCH: This is the number in time/unites per inch that will be displayed when a survey is looked at or plotted out. (100 hours per inch, etc.) This can almost be any number you want.

X LABEL: This can be anything you want, depth, pounds, temperature, etc..

Y START: This could be temperature, pressure-in pounds, etc., (lowest number) that the plot will start at when you view the survey on the monitor or plot out the survey on a printer/plotter.

PRUETT INDUSTRIES INTERNATIONAL

8915 ROSEDALE HWY • BAKERSFIELD, CA 93312 • 805/589-2768

TELEX 4992440 PRUETT INT

FAX 805/589-3268

Y UNITS/INCH: This is the number of degree's/pounds/units per inch that will be displayed when a survey is looked at or plotted out. (50 deg. per inch, etc.) This can almost be any number you want.

Y LABEL: This can be anything you want, temperature, pounds, etc..

X HI VALUE: The number in parenthesis (1145.0), is the highest number in the survey or file shown in the "PRIMARY OR OVERLAY" file/s line for the "X" axis. The number to the far right on this line, is the highest number the plot will show according to the parameters that were programmed in. **YOU WANT TO MAKE SURE THAT THE NUMBER AT THE FAR RIGHT, IS HIGHER THAN THE NUMBER SHOWN IN PARENTHESIS. (1145.0) 1400.00.** This will insure that all data will be processed and displayed.

Y HI VALUE: The number in parenthesis (333.5), is the highest number in the survey or file shown in the "PRIMARY OR OVERLAY" file/s line for the "Y" axis. The number to the far right on this line, is the highest number the plot will show according to the parameters that were programmed in. **YOU WANT TO MAKE SURE THAT THE NUMBER AT THE FAR RIGHT, IS HIGHER THAN THE NUMBER SHOWN IN PARENTHESIS. (333.5) 350.00** This will insure that all data will be processed and displayed.

(C) Pruett Industries

.ew text file
.ot survey
:tup
:ad File
:ad Overlay
:it

STATUS

Plotter	HP Laser Jet III
Paper Size	8.5" by 11"
Orientation	Landscape
Sub-Tics	Yes
Video Plot	Yes
Primary File	[S1KR#15-.SUB]
Overlay File	()
Copies	1

X start		0.00
X units/inch		100.00
X label		TIME
Y start		0.00
Y units/inch		50.00
Y label		PRESSURE

X hi value	(0.0)	900.00
Y hi value	(0.0)	350.00

PLJ Ver 1.0

Thu 11/04/93 11:39:33 Am

(C) Pruett Industries

.ew text file
lot survey
:tup
:ad File
:ad Overlay
:it

STATUS

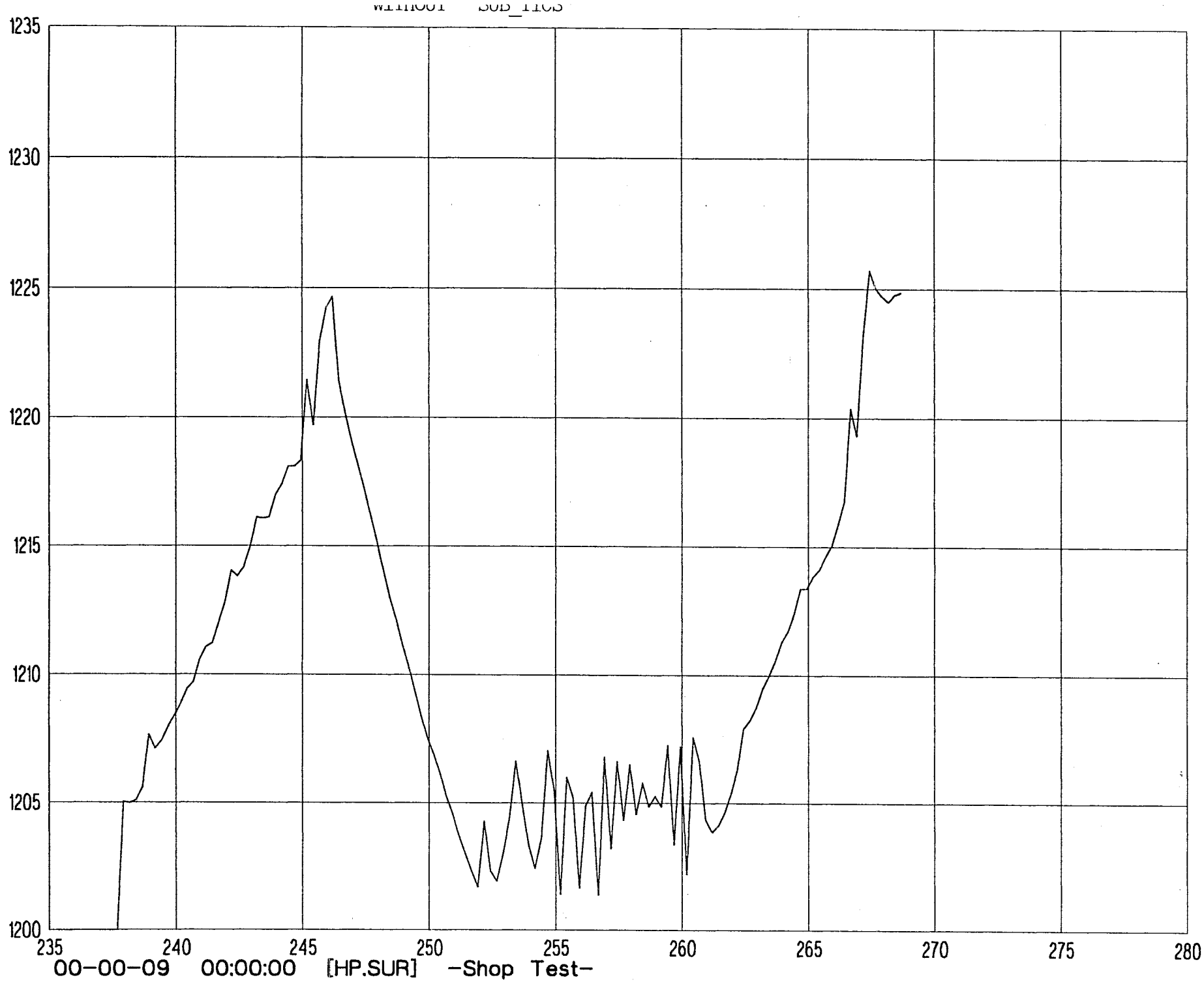
Plotter	HP Laser Jet III
Paper Size	8.5" by 11"
Orientation	Portrait
Sub-Tics	Yes
Video Plot	Yes
Primary File	[S1KR#15-.SUB]
Overlay File	(S1KR23-R.SUB)
Copies	1

X start		0.00
X units/inch		100.00
X label		TIME
Y start		0.00
Y units/inch		50.00
Y label		PRESSURE

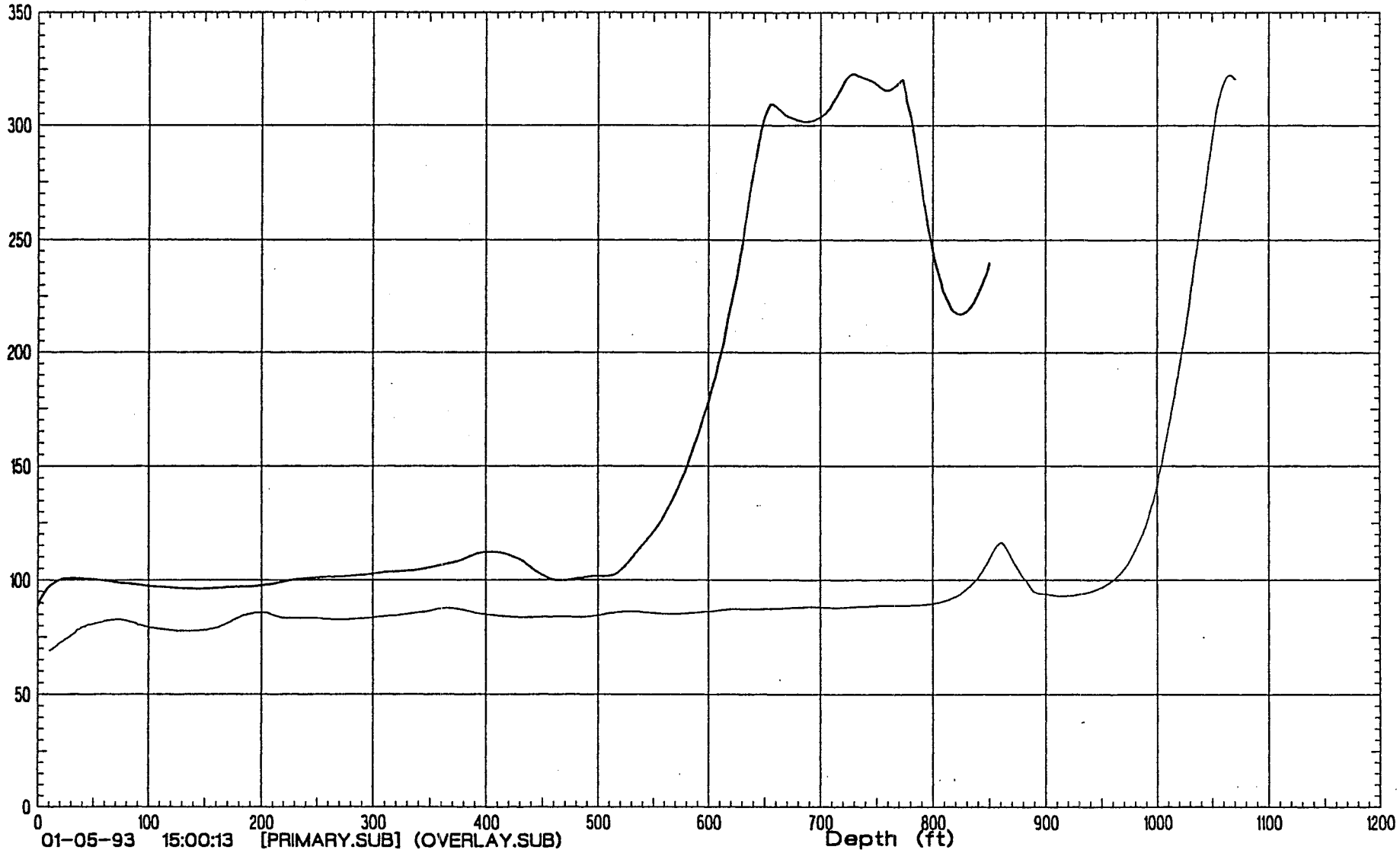
X hi value	(0.0)	900.00
Y hi value	(0.0)	350.00

PLJ Ver 1.0

Thu 11/04/93 11:41:07 Am


1235
1230
1225
1220
1215
1210
1205
1200
235
240
245
250
255
260
265
270
275
280
00-00-09 00:00:00 [HP.SUR] -Shop Test-

WITH "SUB-TICS"



PRUETT INDUSTRIES INTERNATIONAL

8915 ROSEDALE HWY • BAKERSFIELD, CA 93312 • 805/589-2768

TELEX 4992440 PRUETT INT
FAX 805/589-3268

PRUETT INDUSTRIES PLOT SOFTWARE (PLJ VER 1.0)

SETUP BOX (TOP LEFT HAND CORNER)

View text file:
To view the files that have been saved, with the "VIEW TEXT FILE" line highlighted, you can hit the "ENTER" key or hit the "V" key, and all the files saved will be listed. Now, you can arrow down until the file you want to view is highlighted. With the file highlighted, hit the "ENTER" key, and the data in this file will be displayed. The number (1) displayed at the bottom, shows the file number assigned to that file. The file name of the file selected, will also be displayed on line six (6) the "PRIMARY FILE" line of the "STATUS" box. You may use the arrow-up, arrow-down, page up, and or page down to "SCROLL" through the survey file. To exit this setup, hit the "ESC" key, and you will be taken back to the "MAIN" menu.

Plot survey:
If the "PLOT SURVEY" line is selected, by either hitting the "P" key or arrowing down until the "PLOT SURVEY" line is highlighted and then hitting the "ENTER" key, the file shown on the "PRIMARY FILE" line will be plotted out on the screen providing the "VIDEO PLOT" has been turned on or selected.
If there is a file indicated on both the "PRIMARY FILE" line and the "OVERLAY FILE" line, both files will be plotted out on the screen. The "PRIMARY FILE" will be plotted out first, then followed by the "OVERLAY FILE". If you have a color monitor, the "PRIMARY FILE" will be plotted in black, and the "OVERLAY FILE" will be plotted out in green.

SETUP:
This can be accessed by either hitting the "S" key or by arrowing down until the "SETUP" line is highlighted and hitting the "ENTER" key.
This will allow you to choose between two (2) different types of printer/plotters, lines 1 and 2. The next two (2) lines, will allow you to choose between two (2) different sizes of paper, lines 3 and 4. Lines 5 and 6, will allow you to choose between the "LANDSCAPE" or "PORTRAIT" orientation. The "LANDSCAPE" orientation will plot out so that you will look at the plot being held in the horizontal position. With the "PORTRAIT" orientation, the plot (paper) will have to be held in the vertical position.
The seventh line is for the "SUB-TICS". "SUB-TICS", add 1/10 inch graduations between the inch lines. With the "SUB-TICS" chosen, there will be graduation marks on the scales when a file is plotted out. Without the "SUB-TICS" chosen, there will be no graduation lines shown when a file is plotted out.

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Lines eight (8) and nine (9), let you choose between the file being plotted out on a printer/plotter or displayed out on the video display. If you select the "PLOTTER", you will not be able to view the file on the video screen, and if you choose the "VIDEO", you will not be able to plot out the file on the printer.

The tenth (10th) line is the "SCALE PLOT AREA" line. This will allow you to set all the parameters for plotting out the files or surveys that have been saved. To exit this setup, hit the "ESC" key.

When you have selected a file to be plotted out, if you look in the "STATUS" box, it will show you the highest value for the "X" and "Y" axis. This will be shown like (1092.0) in the bottom two (2) lines with the highest parameter show to the right you have selected or entered in. This will let you know if the values you have selected will be high enough to allow the entire survey to be plotted out or viewed. Hit "ESC" to get back to the main menu.

You also have the capability of labeling the "X" and "Y" axis the way you want. This is done on lines three (3) and six (6).

The last line, line number eleven (11) will allow you to choose the number of copies of the survey you can print out at one time.

View Files

Files
P.SUR
1KR#15-.SUB
1KR23-R.SUB
2

View Files

0.0000	14.272	0	0
0.0167	14.259	0	0
0.0333	14.234	0	0
0.0500	14.242	0	0
0.0667	14.218	0	0
0.0833	14.245	0	0
0.1000	14.232	0	0
0.1167	14.251	0	0
0.1333	14.248	0	0
0.1500	14.240	0	0
0.1667	14.234	0	0
0.1833	14.242	0	0
0.2000	14.245	0	0
0.2167	14.264	0	0
0.2333	14.250	0	0
0.2500	14.277	0	0
0.2667	14.256	0	0
0.2833	14.258	0	0
0.3000	14.248	0	0
0.3167	14.256	0	0
0.3333	14.266	0	0
0.3500	14.269	0	0
0.3667	14.248	0	0

HP.SUR

(C) Pruett Industries

Setup

- HP Laser Jet III
- HP Laser Jet 4L
- 8.5" by 11"
- 8.5" by 14"
- Landscape
- Portrait
- Sub-Tics
- Plotter
- Video

ıle plot area
›ies

<ESC=Exit>

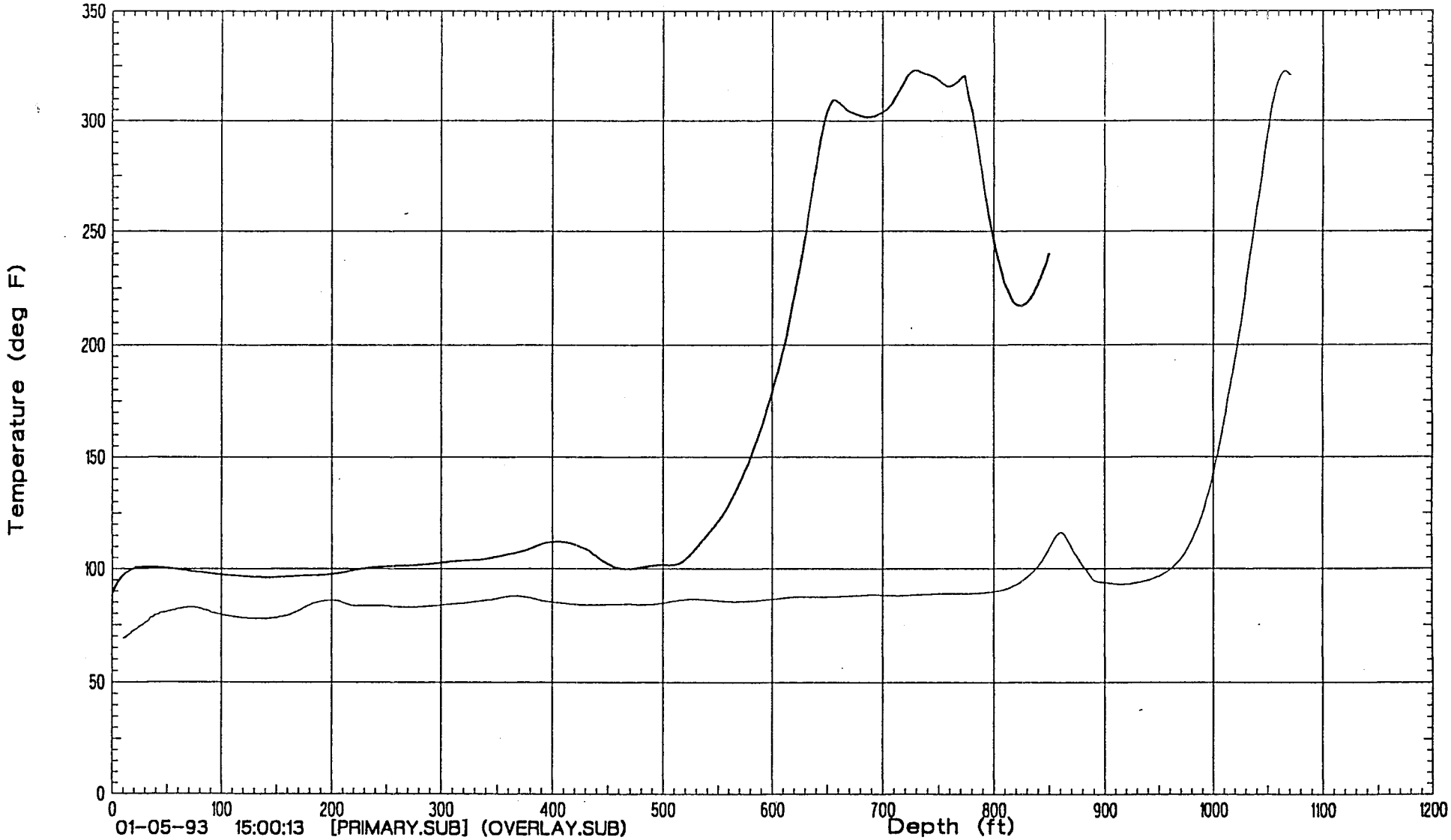
STATUS

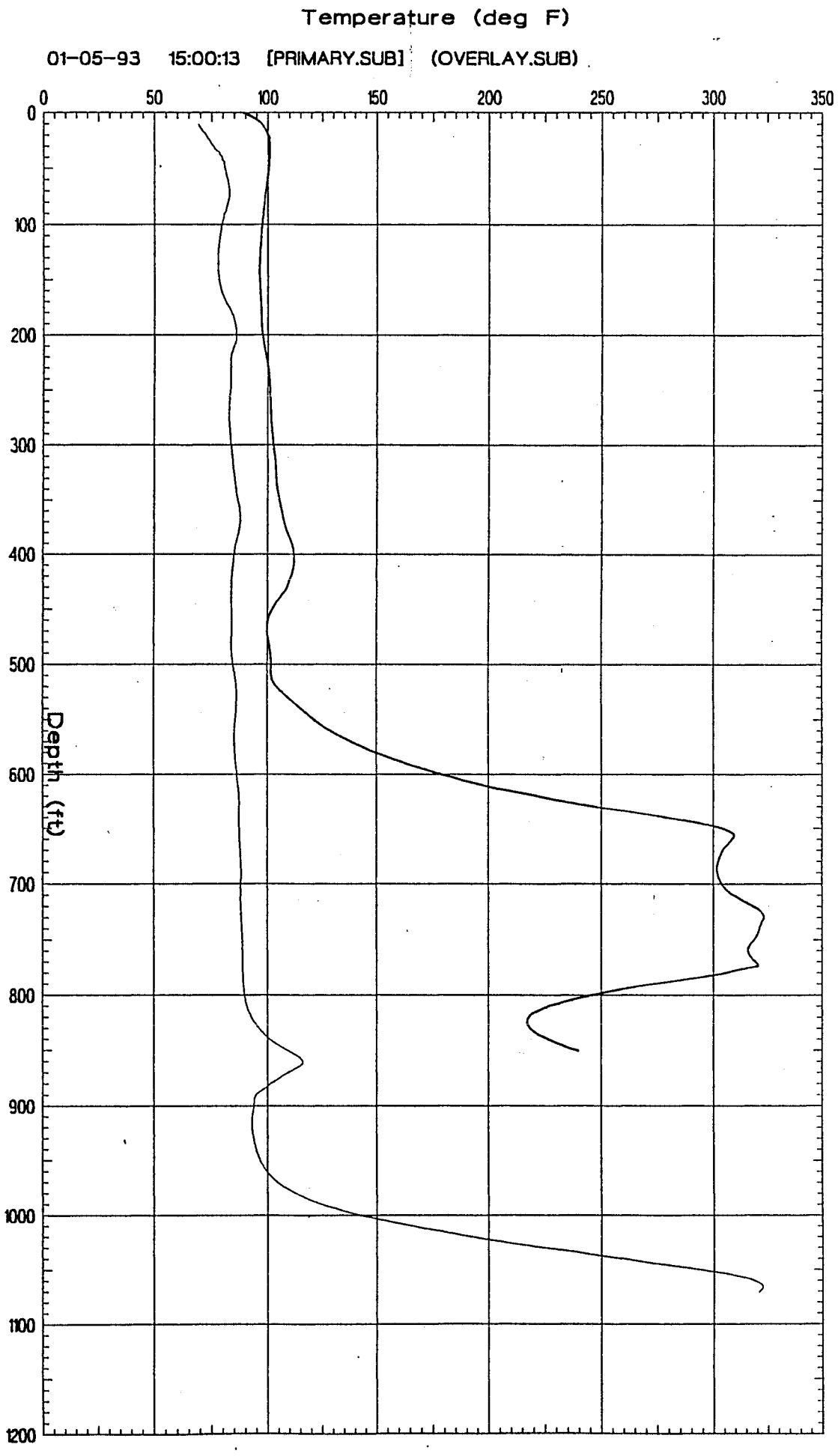
Plotter		HP Laser Jet III
Paper Size		8.5" by 11"
Orientation		Portrait
Sub-Tics		Yes
Video Plot		Yes
Primary File		[S1KR#15-.SUB]
Overlay File		(S1KR23-R.SUB)
Copies		1
X start		0.00
X units/inch		100.00
X label		TIME
Y start		0.00
Y units/inch		50.00
Y label		PRESSURE
X hi value	(0.0)	900.00
Y hi value	(0.0)	350.00

PLJ Ver 1.0

Thu 11/04/93 11:42:34 Am

"LANDSCAPE"


Temperature (deg F)
350
300
250
200
150
100
50
0
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
Depth (ft)
01-05-93 15:00:13 [PRIMARY.SUB] (OVERLAY.SUB)


Temperature (deg F)
01-05-93 15:00:13 [PRIMARY.SUB] (OVERLAY.SUB)
0
50
100
150
200
250
300
350
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
Depth (ft)

"PORTRAIT"

APPENDIX III-C

Instructions for Modification to MS-1

PRUETT INDUSTRIES INTERNATIONAL

8915 ROSEDALE HWY • BAKERSFIELD, CA 93312 • 805/589-2768

TELEX 4992440 PRUETT INT
FAX 805/589-3268

OCTOBER 28, 1993

INCLOSED ARE THE INSTRUCTIONS FOR THE MODIFICATION THAT WAS DONE TO YOUR MS1. THIS MODIFICATION WAS THE ADDITION OF AN A.C./D.C. SWITCH THAT WILL ALLOW THE MS1 TO BE RUN ON A.C. POWER AS WELL AS D.C. POWER AS IN THE PAST.

ANY QUESTIONS, PLEASE FEEL FREE TO CALL.

APPENDAGE 1

Modification made to the MS1 Power Selection capability. The modification was the addition of an A.C./D.C. operation switch.

1. D.C. OPERATION:
   For D.C. operation, the A.C./D.C. switch needs to be in the D.C. position and with the INTERNAL/EXTERNAL switch, you can choose to either use the INTERNAL battery source or you have the option to use an EXTERNAL battery source.

2. A.C. OPERATION:
   For A.C. operation, the A.C./D.C. switch needs to be in the A.C. position and the INTERNAL/EXTERNAL switch needs to be in the INTERNAL position. If the INTERNAL/EXTERNAL switch is in the EXTERNAL position, no power will be provided to the MS1.

When not in use, the MS1 should be stored with the INTERNAL/EXTERNAL switch in the OFF position and the A.C./D.C. switch should also be set in the OFF

APPENDAGE 1

Modification made to the MS1 Power Selection capability. The modification was the addition of an A.C./D.C. operation switch.

1. D.C. OPERATION:
   For D.C. operation, the A.C./D.C. switch needs to be in the D.C. position and with the INTERNAL/EXTERNAL switch, you can choose to either use the INTERNAL battery source or you have the option to use an EXTERNAL battery source.

2. A.C. OPERATION:
   For A.C. operation, the A.C./D.C. switch needs to be in the A.C. position and the INTERNAL/EXTERNAL switch needs to be in the INTERNAL position. If the INTERNAL/EXTERNAL switch is in the EXTERNAL position, no power will be provided to the MS1.

When not in use, the MS1 should be stored with the INTERNAL/EXTERNAL switch in the OFF position and the A.C./D.C. switch should also be set in the OFF

APPENDIX III-D

Pruett Mini-Max Datalogger Program Operations Manual

PRUETT INDUSTRIES, INC.

PRUETT MINI-MAX DATALOGGER PROGRAM

Operations Manual

MARCH 1990

WE RECOMMEND THE OPERATOR READ ALL DOCUMENTATION, AND RUN A PERFORMANCE TEST, TO ENSURE HIS UNDERSTANDING OF ALL EQUIPMENT AND SOFTWARE BEFORE USE IN THE FIELD.

SET UP PROCEEDURE FOR THE TRANSPORT MS1

The new hand-carried MS1 contains an IBM compatible computer which is used for data aquisition from the MINI-MAX LOGGER. Data is retreived through the COM 1 RS232 serial port.
This same unit running the TR9 software can be used for real time data aquisitiion by plugging one of Pruett's self-contained quartz transducers directly in to the six pen amphenal plug on the side.

1. When the main switch is turned off on the transport MS1, all power to the computer is off. When switched on, a warning will appear telling the operator the battery has been discharged. Hit ENTER to continue.

   If the computer is turned on WITHOUT the MM operations disk, use the computer utility programs, DATE & TIME to input the correct date and time. If the computer is turned on WITH the MM disk in the A: Drive, the MM program will prompt you to input the time and date. This is to insure correct data aquisition.

2. The clock time and date on your PC computer, will be used to set time and date when saving the program to the Mini Max DATA LOGGER.

3. A SEPERATE DISK SHOULD BE CREATED FOR EACH MINI-MAX AND CANNOT BE INTERCHANGED.

   This disk will contain all the necessary parameters required by the MM program to insure accurate data translation. Using the wrong disk will cause ALL RAW DATA TO BE CONVERTED INCORRECTLY.

4. Always attach the transfer cord from the logger to the computer, and turn the logger power switch ON BEFORE running the MM program.

SET UP PROCEEDURE FOR THE MINI-MAX LOGGER

1. The Mini-Max is a continuously active device. If it is not being used for data logging, store with power switched off.

   NOTE: When the power supply has been turned off, all previous data and settings are erased and the logger must again go through an initial set-up proceedure.

2. Be sure to attach all Port cable connectors in sequence. For example, #1 thru #4 for pressure and #5 thru #8 for temperature.

3. If your Mini Max Unit contains an internal transducer, that transducer will always be attached to Port #1 of the logger. The external port labeled #1 will not be connected. Any additional pressure transducers will start at Port #2 and go thru Port #4.

   Pressure transducer wiring:

   The connector cables that are used to connect external transducers to the Mini Max are wired as follows: Pin B from the transducer goes to Pin B on the Logger. Pin F on the transducer goes to Pin F on the Logger. Pin A on the transducer goes to Pin D on the Logger. Pin E on the transducer goes to Pin C on the Logger. This cable is connected to the Out Port on the Pruett self-contained transducer units.

   Temperature transducer wiring:

   The Mini Max also allows you to connect up to four temperature probes (thermocouple type). The temperature wiring for port #5 has the red (negative lead) wire to AG, and the yellow (positive lead) wire to 5H. Port #6 has red to AG, and yellow to 2L. Port #7 has red to AG and yellow to 3L. And Port #8, has red to AG and yellow to 1H.

   REMEMBER, THESE PORTS MUST ALSO BE USED IN SEQUENCE.

MM - DATALOGGER RECORDING PROGRAM

The MM program is used for data aquisition from the Pruett Mini-Max Logger, through the COM 1 RS232 serial port. It operates on most IBM compatible computers using MS DOS. A color monitor or monochrome graphics monitor should be used. We recommend our Pruett MS1 transport computer, designed for simple field use in a rugged, hand carry case. The MM.EXE program and additional operations files will be included on the disk supplied with this manual.

ATTENTION !!

WHEN TURING ON THE LOGGER FOR THE FIRST TIME OR WHEN BEGINNING A NEW SURVEY:

The Mini-Max logger should have been stored with the power OFF. Connect the cable from the computer (MS1) to the logger. Turn the Mini Max power switch ON. Load the operations disk into the computer, turn it on and you will be prompted to enter the correct time and date. Call up the MM program, and choose the main menu options in this order:

First, update all port settings.
Next, input the correct field and interval.
Now, save program to Controller.

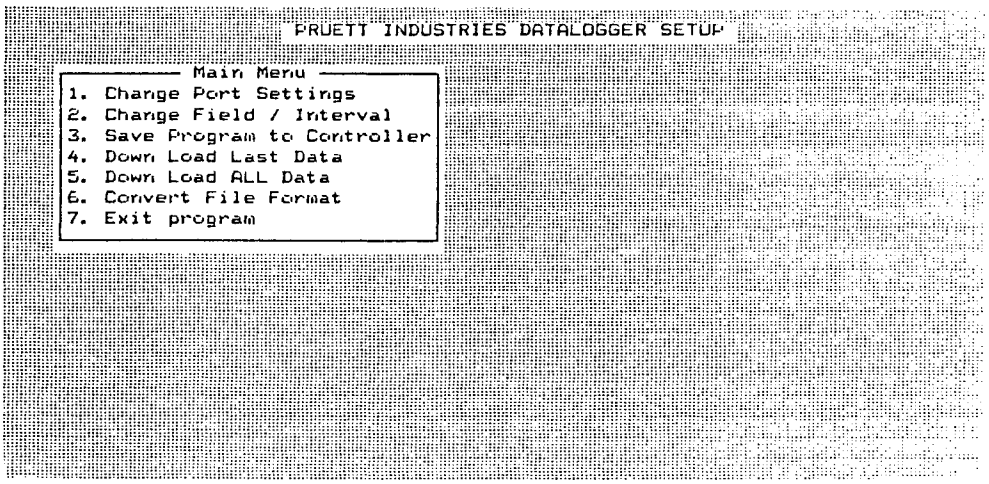
A file called PRUETT.DLD will be created on the disk at this time. This file contains all times, intervals, names, transducer coefficients, etc. FOR ONE SPECIFIC MINI MAX. ALWAYS DOWNLOAD AND CONVERT DATA FROM THE LOGGER BEFORE CHANGING PROGRAM SETTINGS.

When the first data is downloaded from the logger, it will begin at the time and date which was saved to the controller.

Each program option will be explained in detail on the following pages.

When the operations disk has been loaded, type MM and hit ENTER to start the program.

The screen will display the Main Menu.



Selections from each menu can be made using the appropriate number selection and ENTER , or by moving the highlighted bar with the up or down arrow keys to the correct option and ENTER.

NOTE: Use the ESC key to return to previous menus.

CAUTION: Once a program has been sent to the controller, always download the existing file from the datalogger, and convert, before changing any file settings!

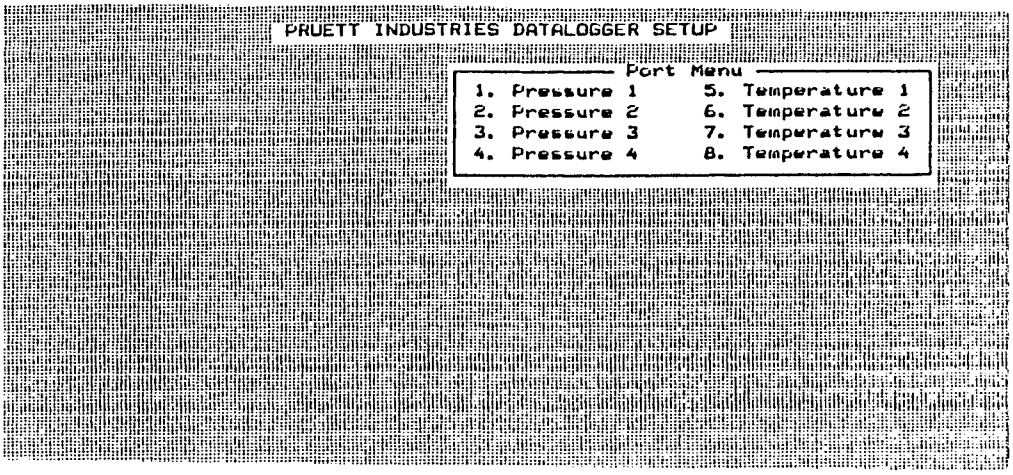
Review the set up proceedures for the Transport MS1 to insure proper use of the MM.EXE program.

All NEW settings will be stored in a NEW PRUETT.DLD file and used when the next data file is downloaded. The old file will have been written over.

To begin initial set-up for the datafile collection, choose:

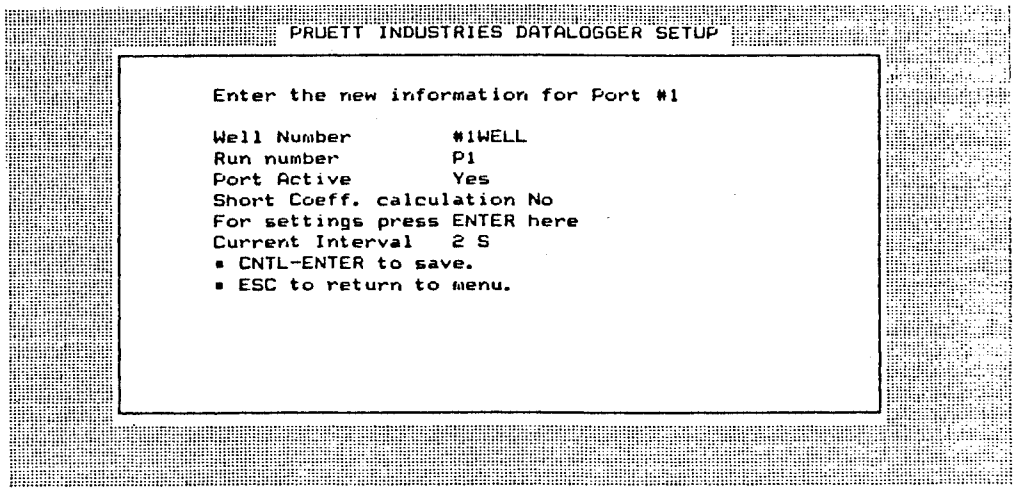
----- 1. CHANGE PORT SETTINGS -----

The screen below will appear:



Select the Port Number you wish to set up or change by moving the highlighted bar with your arrow keys, or choosing the correct number and ENTER.

An example of the screen display for Pressure Port #1 is shown here:



.... Well Number and Run Number ....

When first setting-up, there will be no information in the file. You must input the well name and run number.

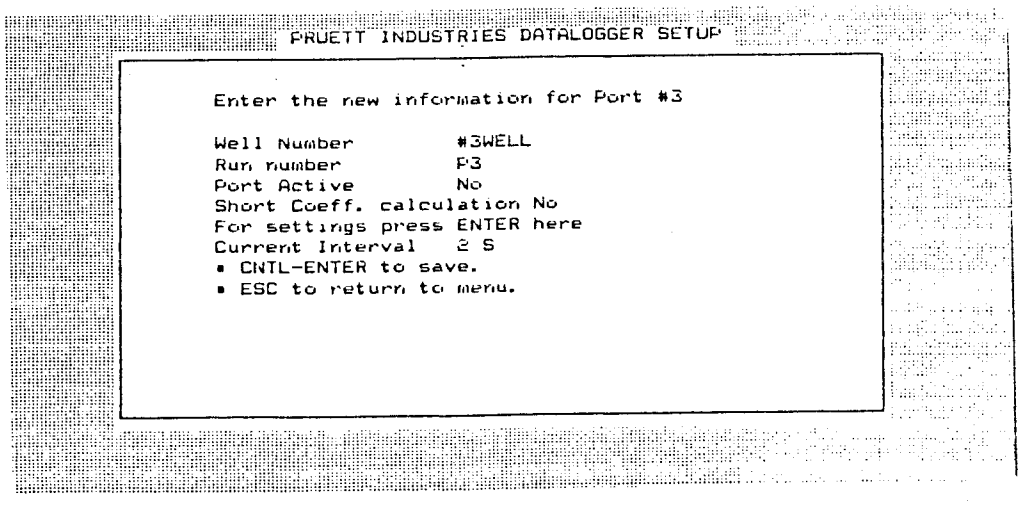
NOTE: The run number should be a 2 character identification of the data file (such as 1A for the first file of port #1, 2A for the first file of port #2, etc.)

.... Port Active ....

When attaching transducers to the MINI-MAX, be sure to hook them up in sequence, Port #1, #2, #3, #4. Port #1 must ALWAYS BE ACTIVE when collecting pressure data.

If, for example, the transducer on Port #3 must be disconnected, move the transducer from Port #4 into this location. Now re-enter the port information, including the correct co-efficients, and deactivate Port #4.

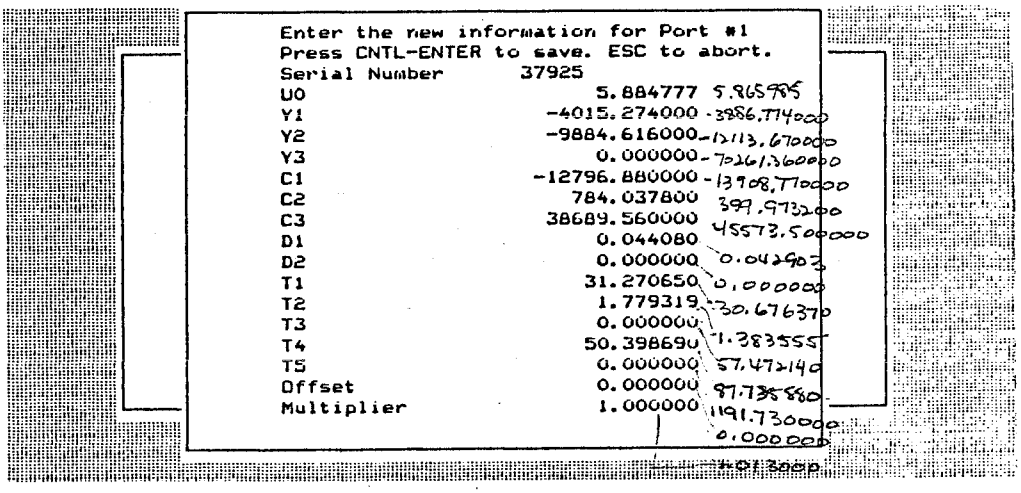
Remember to use the space bar to toggle between YES or NO to activate or deactivate each Port.



NOTE: The next option ..Short Coeff. calculation.. is for Pruett testing proceedures only, and should always display NO.

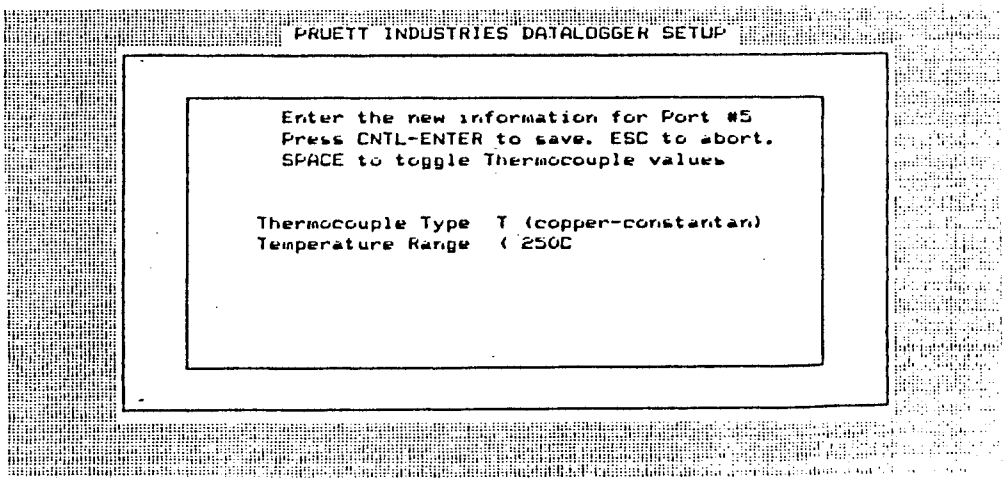
.... Settings ....

To input the transducer information, press ENTER when the cursor is shown at the "settings" line. The next window will allow the user to input all coefficients, an offset if needed, and a multiplier from the Cap Cal Program for pressure transducers. Use 1.0 as the pressure multiplier for PSIA. The transducer serial number is also entered here.



Fill in all coefficient information, then press CNTL-ENTER to save. If you wish to review the settings and not make any changes, abort by using the ESC key. Remember, this only stores the changes to temporary memory, later you must save the settings to disk memory, with the SAVE PROGRAM TO CONTROLLER option. The OLD .DLD file will still be in disk memory until the new program is saved to the controller.

When setting up for a temperature port, the program asks for the type of Thermocouple and Temperature Range as displayed in the window below.



Use the space bar to toggle between 4 different thermocouple types. Select the correct TYPE for each port.

The ...temperature range.. allows the user to select the optimum temperature resolution for the survey. If temperatures will not be going over 250 deg F, choose (( ) less than 250 F range. If survey temperatures will go above 250 deg F, choose ( )) greater than 250 F for the range. Again, the space bar will toggle between options.

CNTL-ENTER to save, ESC to abort and return to the port information window.

.... Current Interval ....

Shows how often the data will be recorded on the logger. This is set from the main menu and is displayed here, but cannot be changed at this time.

Use CNTL-ENTER if you wish to save the new file settings you have entered. Remember this will change the PRUETT.DLD file, and you cannot convert files with OLD transducer settings when operating with this NEW file.

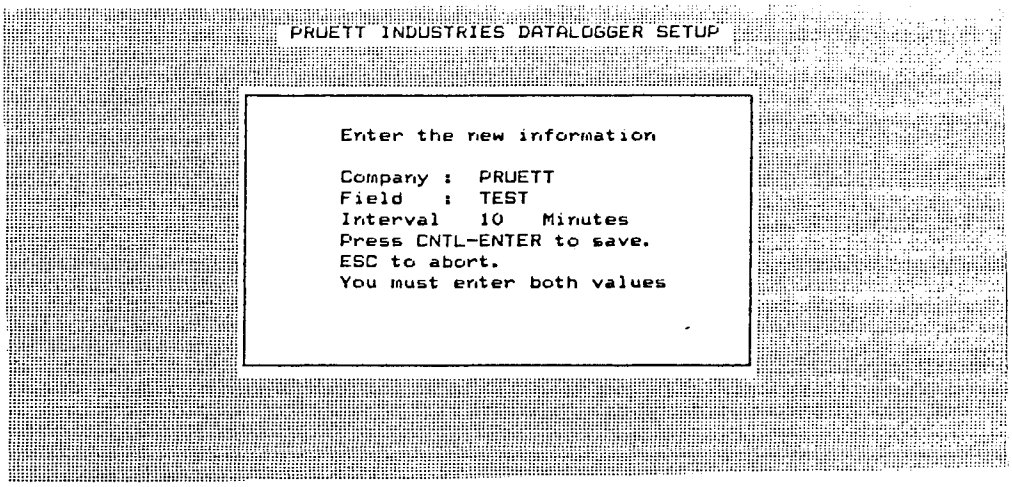
Hit the ESC key to return to the main menu.

----- 2. CHANGE FIELD / INTERVAL -----

To establish a time interval for the Data Logger, choose option number two. This is also where the operator will enter the company and field name.

NOTE: Once a time interval has been sent to the Mini-Max, the operator should download and convert a file before he changes to a new interval.

ALWAYS DOWNLOAD AND CONVERT BEFORE CHANGING ANY SETTINGS WHICH ARE STORED IN THE PRUETT.DLD FILE.



After entering the company name and the field, move to ..Interval.. using the arrow keys, and input a number value.

The Mini Max is currently configured for a maximum of 2 Hour Intervals.

Press ENTER and use the SPACE BAR to toggle between Hours, Minutes, and Seconds. CNTL-ENTER to save.

----- 3. SAVE PROGRAM TO CONTROLLER -----

When option 3 is used, the program that you have created is stored into the Mini Max computer. It will run continuously until the power is turned OFF or a new program is loaded.

First the computer time is sent to the logger, then the program settings. A brief messege appears on the screen while this function is working. This is when the PRUETT.DLD file is updated and saved to disk.

```
TERM: PRELIM    Com1:9600 baud        Datalogger Type: CR10
Option: Download PRUETT.DLD                    Esc = Abort Option

*
*2718H

)

MODE 13
13:00  2
02:(
Wait briefly.

220 bytes sent, received, entered.
220 bytes sent, received, entered.
220 bytes sent, received, entered.
220 bytes sent, received, entered.
220 bytes sent, received, entered.
119 bytes sent, received, entered.
```

----- 4. DOWN LOAD LAST DATA -----

When the operator is ready to retreive data from the MINI-MAX LOGGER, he inserts the MATCHING DISK and chooses this option. Only the data between now, and the last time you downloaded the computer, will be retreived.

CAUTION: DO NOT CHANGE ANY SETTINGS BEFORE DOWNLOADING AND CONVERTING THE FILE FROM THE LOGGER.

An error messege will occur if there is no communication with the MINI-MAX. If communication is established, the screen will display the following:

```
Telecommunications Program  ver. 6d
Copyright (C) 1988,1989 Pruett Industries , Inc.

Warning -file type is not used

Calling Station "PRUETT"

*1A
 R+1198.0 F+1197.0 V3 E00 00 M96 A1 L+1198.0 C2463
*480G
 A1 L+480.00 C0944
*4F
512F
202F
C
 Y90 D0078  T14:14:06 C1290
*E
Next time for "PRUETT" is  3/19/90 14:15:00
Press a key to continue...
```

The " next time " statement shows the earlist time another file can be downloaded with the program -- about 1 minute.

Press a key to continue... and the screen will display several lines of information as the data is being stored.

```
Telecommunications Program  ver. 6d
Copyright (C) 1988,1989 Pruett Industries , Inc.

Warning -file type is not used

Calling Station "PRUETT"

*1A
 R+17047. F+29968. V3 E00 00 M96 A1 L+17047. C2479
*25033G
 A1 L+25033. C1042
*4F
512F
512F
512F
512F
512F
512F
```

The data has now been stored to your computer disk. If you were to look at the disk file at this time, it would be called PRUETT.DAT. The data in the file would look similar to the example below:

```
  1   2   3 4   5   6    7     8      9

146,1990,130,1145,1,5879,3100,471.4,22.23
146,1990,130,1200,1.125,5879,3100,462.4,22.41
146,1990,130,1215,1,5879,3100,456.4,22.46
146,1990,130,1230,1.125,5879,3100,446.3,22.64
146,1990,130,1245,1,5879,3100,434.3,22.62
146,1990,130,1300,1.125,5879,3100,425.3,22.77
146,1990,130,1315,1,5879,3100,419.3,22.95
146,1990,130,1330,1.125,5879,3100,406.2,22.93
146,1990,130,1345,1,5879,3100,399.2,23.11
146,1990,130,1400,1.125,5879,3100,392.2,23.14
146,1990,130,1415,1,5879,3100,384.2,23.2
146,1990,130,1430,1.125,5879,3100,376.1,23.15
146,1990,130,1445,1,5879,3100,374.1,23.13
146,1990,130,1500,1.125,5879,3100,373.1,23.18
```

This file contains:

1. A log identifier,
2. Year,
3. Julian Date,
4. Real Time,
5. Seconds,
6. Temperature Period x 1000 (for press conversion) for each active port,
7. Interger of Press Period after multiplying by 100,
8. Remainder of Press Period after multiplying by 100, plus 1 place to the right of the decimal which is the remainder of temp period (for each active port),
9. Actual temperature for each active port, (after all active pressures have been displayed)

Should there be a problem with the data when it is ready to be processed, an editor such as the PEDIT program can be used to correct the file, while it is in this format. Be sure each line in the file contains ALL the necessary information, before it is converted.

The convert option is looking for a file called PRUETT.DAT. If you convert the file and find that it did not convert correctly, edit the PRUETT.C? file, and rename it PRUETT.DAT, then convert it again.

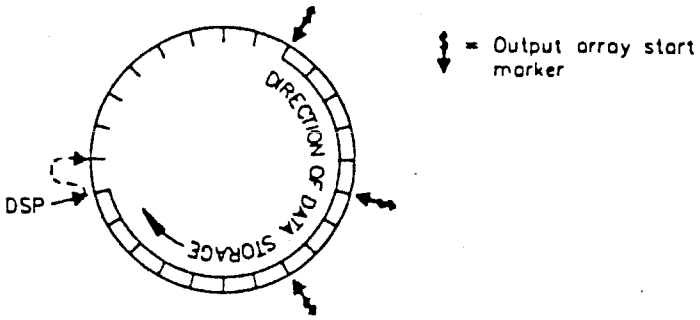
NOTE: Remember you MUST use the correct PRUETT.DLD file when doing this. The .DLD file contains all the information required to properly convert the raw data. You should not save new program settings to the controller before converting a file.

----- 5. DOWNLOAD ALL DATA -----

The Mini Max Logger contains a " Ring Memory ", which is diagramed below. The logger will store up to 3300 lines of data with (1) active pressure port, before the memory is full.

Pressure data requires more memory storage than temperature data. The more ports which are active, the more memory is used. More information will be stored to each data line, so there will be less TOTAL lines available.

When the memory is full, the logger will continue to store data points, but they will begin to WRITE OVER those already in memory.



The Data Storage Pointer (DSP) is used to determine where to store each new data point in the Final Storage area. The DSP advances to the next available memory location after each new data point is stored.

The " Ring Memory " might be discribed like an hour hand moving around the face of a clock. Data storage might begin at 12:00 on the clock, and continue around, completely filling the memory at 12:00. (One full pass around the " Ring "). If more data continues to be collected, (past 12:00), each point collected will now be stored " on top of " the previous data which occupied that spot.

If you continued to collect data until the hand reached 1:00, then DOWNLOADED the file, the data will begin and end at 1:00.

When the operator wants to download ALL data stored in the memory, not just the data since the last download, use this command. Because each line of data contains its own time stamp, all the data retreived will be good.

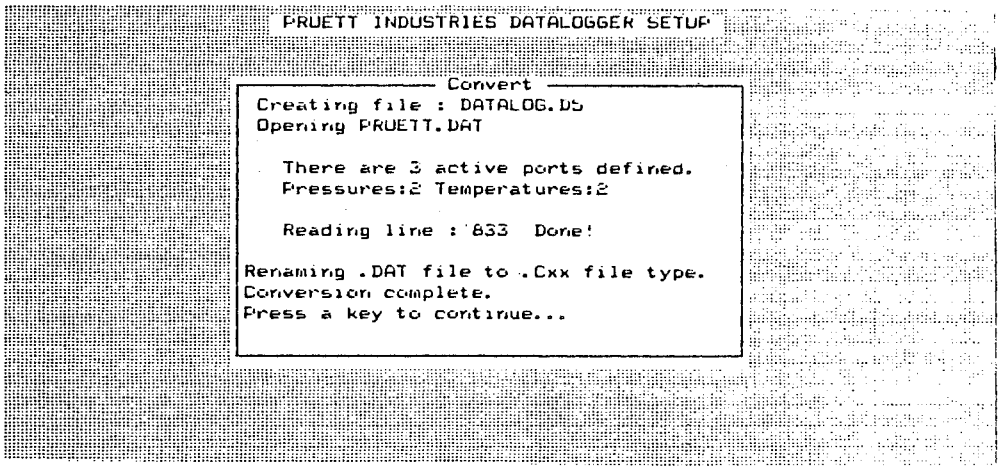
If the settings in the PRUETT.DLD file have been changed, you may need to edit part of the file, as described on the previous page, before converting it.

----- 6. CONVERT FILE FORMAT -----

REMEMBER ALWAYS TO DOWNLOAD and CONVERT A FILE BEFORE MAKING ANY PROGRAM SETTING CHANGES.

Before the data can be processed using previous Pruett Software, it must be changed to the correct file structure using the Convert option.

The screen will display the following information when the file has been sucessfully converted:



There may be up to 4 active pressure and 4 active temperature ports defined. There will always be at least 1 temperature displayed next to Temperatures: (the first temp is always reading the thermocouple reference junction).

NOTE: The PRUETT.DAT file will now be named PRUETT.C1 and the converted file will be called DATALOG.D1. If several data files are stored to the same disk, each new file will be converted to the next number in sequence (ie. PRUETT.C2 DATALOG.D2 etc.).

If you were to view a converted DATALOG.D? file, it would contain information similar to the example below:

```
2
 1 CO FIELD #1WELL P1 0.000  2 CO FIELD #2WELL P2 0.000     90/03/27 12:46:30
30SP1= 213.155
30SP5= 22.494
30SP1= 213.155
30SP5= 22.544
```

The number on the first line, shows how many ports of data have been stored in the file. On the next line(s) there is header information, containing the port number, company name, field, well name, run number, multiplier, offset (if used) date and time.

Each data line shows the interval time, port number, and actual pressure or temperature.

When all functions are complete, return to the main menu to exit the program --- option #7.

Use the previous Pruett CONVERT, COMBINE, PLOT AND REPORT programs to process the "DATALOG" files.

Pruett Industries MINI MAX Data Logger

* Careful Attention should be noted here for proper logging operation.

KA KA 1234

AD KA A.D

The Pruett MINI MAX is a four transducer data logging device that is designed for simple usage and reliable operation. There are NO confusing mechanical switches that must be physically set. ALL device configurations are software selectable through an easy to follow Menu Program.

The output file format is as follows: The first data file line is the Plot Style command for our print and plot software program. the second data file line contains all the company, field, well, date and time header information. There are 29 reserved lines (future) followed by the survey data. The survey data format consists of the the first letter of the transducer type ('P', 'T', 'S', 'O') followed by the time (number of hours after survey start) followed by the acquiring transducers' numeric value stored as a decimal number.

This manual has been split into four main sections.

Section 1 gives a brief description of the overall use of this product and the associated equipment needed for viable operations.

Section 2 deals with proper procedures for installing the system and preparing it for a survey.

Section 3 describes in detail the proper setup for the survey requirements.

Section 4 explains the computer assisted support program to minimize the current survey setup and supply an effective human-to-machine interface.

Storage: 3400 Data Points

Display: Current transducer value shown or 'Hold' to indicate that the survey is in standby mode (not recording).

RTC: Real Time Clock & Calendar keeps accurate time and automatically adjusts for leap years. This clock will stop only when power is removed from the unit or when the operator resets the RTC to a new time.

Interval: 5 seconds to 18 hours/point in 1 second increments.

Transducers: Up to 4 different transducer types can be recorded independently or in combination with others. (1 of each type only)

Device Type Number (explained in section 3-8)

1. Quartz Pressure
2. Thermocouple
4. Flow Rate/Spinner Transducers
8. Spacial purpose (Custom) Pruett Transducers

Connections: Transducers are 'looped' with one another when more than one transducer type is required. The last device in the loop must have a 'loop termination plug' installed.

Auto Purge: Independent Purge Cycle and Purge Duration intervals are optional functions on this unit. There are two separate switched outputs available. The first is a switched 12 volt power output. The second is a set of DRY (normally open) contacts and is rated at 120 volts AC @ 3 Amps continuous duty. In addition to purging, the second switch may be used for starting motors, turning ON lights, and any other time clock applications. This switching action operates as a 'stand-alone' timer and is totally independent of survey logging operations.

NOTE:
An additional .060 amp of power supply drain is realized during the actual purge ON cycle time.

Communication: RS232c standard serial communications protocol set at 9600 Baud, No Parity, 8 Data bits, 1 Stop bit. This unit is fully compatible with most serial communications software programs currently on the market today.

Logger Power: 9 to 16 volts DC at .030 amp (non purging).

System: The logger software is permanently stored in ROM (Read Only Memory). This means the program does NOT have to be 'loaded' each time for operation of this unit. When initial POWER is applied, the internal display will

indicate 'Hold' and the operating system will send a complete MENU of options through the computer communication cable. Specific transducer commands are built in.

NOTE:
Contact Pruett Industries for other types of transducers you want to attach to this versatile data logger.

Menu: Number(s) followed by selection categories and "FILL-IN" data entry (SETUP). The following example is the actual MENU that will be displayed on your computer screen. The selection categories which will be referred to as FUNCTIONS, are detailed in section 3 of this manual.

Actual Displayed Menu	Comments
(C) 1991 Pruett Industries	' These first 9 lines are
Company Name >	' NOT actual MENU selections
Field >	' but, they will indicate
Well >	' the current system setting
Run >@@	' See Section 3 for a more
@@.SUR	' detailed description.
Cur Interval >00:00:30	
Purge Off	
12/15/92 15:35:07	
1. Resume Survey	
2. Start New Survey	
3. Change Interval	
4. Set Date/Time	
5. Save LAST Data	
6. Save ALL Data	
7. Company Info	
8. Purge On	
9. Purge Off	
10. Device Types 01	
11. Telcom	
?	

An integrated program to allow even easier and faster survey setups. This package is fully MENU driven and most operations are performed by pressing a single key. In addition to easy survey setups, there are several program utilities that allow ON-SITE Real Time data monitoring. Several 'Data Boxes' permit you to see what data is actually being 'seen' by your transducer devices. The logger status is updated every 5 seconds to indicate how many data points have been stored as well as when the memory buffer must be saved. All of the pertinent information about the survey in progress is displayed in a separate 'Data Box'. A file view and quick plot utility is convenient for checking previously saved data before a new survey is started. The plot utility has auto-scale attributes and a versatile window expander (ZOOM) feature. Several types of line printers may be used with this program. If the required printer is not in the list, a common word processor can be used to 'configure' your own printer for proper printing & plotting functions. Included is a special comment log that allows the operator to make notes that correspond to a particular survey file. This log 'stamps' the file name along with the operator comments and the length is limited only by the amount of free disk space. These utilities can be utilized without stopping the survey in progress. Provisions have been made to permit usage of the utilities back at the office without the logger equipment being physically attached.

The minimum required equipment is a PC compatible machine with DOS 2.0 or later, 512K minimum memory and CGA, EGA, VGA or an LCD monitor with graphics capability. There is no setup required for high resolution display devices. The program is auto-display seeking and will adjust the plot routines accordingly.

NOTE: None of the equipment will be damaged if these steps are not followed. However, power-up spikes may cause undesired effects (possible loss of data!).

1. The MS-1 computer interface cable is NOT plugged into the MINI MAX, UNLESS the MS-1 is powered up!.

2. Skip this step if your MINI MAX is already taking data. Prior to applying MINI MAX power, a transducer must be plugged into the proper port (far right plug). Be sure that a 'loop plug' is installed at the last transducer 'out' connector. This will allow auto-id required for some transducer types.

3. Turn ON power to the MS-1 and wait for the DOS prompt. type A: followed by the <ENTER> key. Notice your A> prompt.
   DO NOT run any programs yet.
   You may now connect the MINI MAX computer interface cable at this time.

4. Skip this step if your MINI MAX is already taking data. Plug in MINI MAX power now. (Battery or AC adapter) The MINI MAX is ready for use in less than 1 second.

5. Insert the MLOG program disk into disk drive A: Type "MLOG" and press the <ENTER> key. After a few seconds, you should see some data boxes. The program is initializing the communications link and will wait up to 20 seconds for a response. You should NOT press any keys at this point unless you are using this program as a Plot Utility only.
   If you do not see the center box 'vanish' and the MAIN MENU within 20 seconds, check all MINI MAX cables.

6. If the MAIN MENU appears in the upper left box, please go to section 4 and continue the logger setup.

MINI MAX MENU: Line 1 of the menu displays Pruett Industries copyright.
Line 2 should indicate your Company Name. See function number 7 for entering this data.
Line 3 shows the current Survey Field Name. Function 7 also sets the Field Name.
Line 4 shows the current Survey Well Name. Function 7 also sets the Well Name.
Line 5 shows the current Survey Run Number. Function 7 also sets the current Survey Run Number.
Line 6 will show the recommended Survey File Name after Function 7 data has been entered.
(This file name has been created by the Run, Field, Well name and adds '.SUR' as the DOS extension).
Line 7 shows the current Interval Setting. Function 3 sets the Interval.
Line 8 shows the current Purge Status. Functions 8 & 9 sets or clears the Purge Operation. If the purge Function has been turned ON, this line (7) will display 'Purge On HH:MM:SS, HH:MM:SS' (Cycle Dur)
Line 9 shows the current survey file name. If you notice '@@.SUR', then you need to enter all the Company Info (Function 7). The survey file name is built up by the run number, field name, and well name.
Line 10 shows the Date 'MM/DD/YY' & Time 'HH:MM:SS'
The Next 11 lines (numbered 1 to 11) are the actual MENU Items. Notice the '?' at the bottom of your screen. This is where you will enter your selections.

Data Entry Conventions 3-1-1

Note: <CR> = Carriage Return or the ENTER key.
When entering numbers, all spaces are automatically skipped, and will not cause any problems.
Date Format: MM/DD/YY (Month/Day/Year)
The following Date entry conventions are all permitted

12/15/91	12-15-91	12,15,91
01/04/92	1/4/92	1,4,92

Time Format: HH:MM:SS (Hours:Minutes:Seconds)
The following Time entry conventions are the same as Date.

10:07:05	10:7:5	10,7,5
15:01:30	15:1:30	15,1,30
00:03:00	0:3:0	,3 (this works fine)

Section 3-2 to 3-9 assumes you are using a communications software program (Without MS-1 Program).
Section 4 explains how the MS-1 program does most of the work for you.

Resume An On Going Survey 3-2
FUNCTION 1.

CAUTION: You should never use this function to start a NEW or first time survey. Always use Function number 2 for first time surveys.

At the '?' prompt, press the '1' key followed by <CR>.

Note 3-2-A: If you wish to see the data, press the 'D' key (Display). To stop the display, press the 'E' key (End display). You should not leave a running survey without pressing the 'E' key a couple of times.

*** Function 1 does NOT erase any survey data. ***

Starting A NEW Survey 3-2-1
FUNCTION 2.

CAUTION: Be SURE that the Date & Time, Company Info, and the correct Interval HAVE been SET before selecting Function 2.

At the '?' prompt, press the '2' key followed by <CR>.
Notice the following Messages:

'ERASE ALL DATA!'
'Are You Sure? (Y/N) >'

Just in case we forgot to save the previous survey data, the program gives us one chance to change our mind. Any key other than the 'Y' key will abort this Function and return to the MAIN MENU. You must press the 'Y' key. Do NOT press the <CR> key!. The Function #2, second prompt (safety) is the only place we do NOT follow up with a <CR>.
*** Function 2 ERASES ALL survey data! ***
Please read above Note 3-2-A

Changing the Current Interval 3-3
FUNCTION 3.

Note: If your MINI MAX is currently taking data (running), you must press <CR> to temporarily 'halt' the survey. The internal display will indicate 'Hold'. In less than one second, the MAIN MENU will appear.
At the '?' prompt, enter '3' followed by <CR>. You should see the prompt 'New Interval HH:MM:SS >'
The minimum range is 00:00:05 (5 seconds)
The maximum range is 18:12:15 (18 hours, 12 minutes, 15 sec)
Enter your new interval using the format described in section 3-2-A. After entering the new interval, press the <CR> key. Be sure to view line 7 to verify that your selection is what you entered.
*** Function 3 does NOT erase any survey data. ***

Setting the Date and Time of Day 3-4
FUNCTION 4.

Note: Press THE <CR> key to 'halt' the survey.
At the '?' prompt, enter '4' followed by <CR>. You should see prompts 'Date, Time'
'MM-DD-YY,HH:MM:SS >'
Enter the Date using the format described in section 3-2-A. After the Date, BE SURE to enter the ',' (comma) character. You may now enter the current Time (format in 3-2-A) and press the <CR> key. Be sure to view line 10 to verify that the correct Date & Time have been entered.
*** Function 4 does NOT erase any survey data. ***

Saving the Survey (down load) 3-5

Save Last Data Only 3-5-1
FUNCTION 5.

Note: Use Function 5 only to save current data since your last save. This Function does NOT save all of the MINI MAX data. Function 5 is mainly used to save current data in memory, to the MS-1 disk without destroying the current logger memory. The MINI MAX will remember where it left off and when you resume survey (Function 1), the next data point(s) will begin at this location of memory. This is useful for analyzing the data before it is 'erased'.
Procedure: If you are using the MS-1 program, please go to section 4-7 for this process. If you are using another program such as 'PRO COM', 'CROSS TALK', 'QMODEM' etc., then perform the following procedure: Press the <CR> key to halt the survey. At the '?' prompt, enter '4' followed by <CR>.
Notice the messages 'Turn ON CAPTURE, Press any Key'
'XXXXXXXX.SUR' (note: XXXX=file name)
Consult your communications program manual on how to 'capture' a file. After you set the capture ON, press the <CR> key once. You should notice the header data followed by several lines of data values. When this scrolling action stops, turn the capture OFF (consult your manual).
*** Function 5 does NOT erase any survey data. ***

Save ALL MINI MAX Survey Memory 3-5-2
FUNCTION 6.

Function 6 operates in the same manner as Function 5 (3-5-1)
The only difference is that this Function save all survey data points starting from the first data point collected.
Note: You may save ALL data (this Function), then resume the current survey (Function 1).
You can use this Function as many times as you desire.
*** Function 6 does NOT erase any survey data. ***

FUNCTION 7.

Note: Press THE <CR> key to 'halt' the survey.
Function 7 is divided into four sections. Remember, all letters that you enter in this Function will automatically be CAPITALIZED. This saves a little time and renders easier reading afterwards.

At the '?' prompt, enter '7' followed by <CR>.
You should see the prompt 'Company Name >'
Enter your company name + <CR>.

You should now see the prompt 'Field >'
Enter the current field name and/or number(s) + <CR>.
Note: spaces (' ') are NOT permitted in this reply.
There must be at least two (2) characters entered.

You should now see the prompt 'Well >'
Enter the current well name and/or number(s) + <CR>.
Note: spaces (' ') are NOT permitted in this reply.
There must be at least four (4) characters entered.

You should now see the prompt 'Run >'
Enter the starting run number + <CR>.
The proper format is:
A single digit (1-9), followed by a single letter (A-Z).

After these four items have been entered, be sure and verify the results. If you discover an error, perform this section until you are satisfied with your selection.
*** Function 7 does NOT erase any survey data. ***

Auto Purging ON 3-7
FUNCTION 8.

Note: Use this Function ONLY if there is an additional requirement for 'time switching' an external event.

Press the <CR> key to 'halt' the survey.
At the '?' prompt, enter '8' followed by <CR>.
You should see the two messages 'Purge Cycle, Duration'
'HH:MM:SS,HH:MM:SS >'
Enter the Purge Cycle time, then ',' (comma) followed by the desired Purge Duration (how long the purge valve is kept OPEN), + <CR>.

Verify that the purge status line shows 'Purge On' and that the cycle and duration are what you requested.

CAUTION: Be sure that the Purge Duration (ON time) is LESS than the Purge Cycle time! (Your valve may stay OPEN)
*** Function 8 does NOT erase any survey data. ***

Disable Purging (OFF) 3-7-1
FUNCTION 9.

Note: Press the <CR> key to 'halt' the survey.
At the '?' prompt, enter '9' followed by <CR>.
Verify that the Purge Status line reflects 'Purge Off' and that there are NO Purge times shown.
*** Function 9 does NOT erase any survey data. ***

FUNCTION 10.

Note: Press the <CR> key to 'halt' the survey.
At the '?' prompt, enter '10' followed by <CR>.
Notice the first 5 messages:
'1 = Quartz'
'2 = Thermocouple'
'4 = Spinner'
'8 = Special'
'I.E. 3 = Quartz & Therm'

The numbers '1, 2, 4, 8' are ADDITIVE. For clarity, consider a situation where you want to record temperature and spinner data at the same time. The above table tells us that we must select the Thermocouple & Spinner. Just add them together (2 + 4 = 6). You would enter '6' for the correct transducer operations.
At the 'Recorder Type>' prompt, enter your selection followed by <CR>.

MAIN MENU item '10' should reflect your selection.
*** Function 10 does NOT erase any survey data. ***

Function 11.

Note: Press the <CR> to 'halt' the survey.
Use this Function only for direct communications to the individual transducer(s).

At the '?' prompt, enter '11' followed by <CR>.
Notice the message ''^X (Control X) To Exit'
To exit this Function, hold the 'Ctl' key down, and before releasing the 'Ctl' key, press the 'X' key.
Note: If no key is pressed after 30 seconds, this Function will auto-abort and return the MAIN MENU.
*** Function 11 does NOT erase any survey data ***

As the name of this section implies, the MS-1 program was designed to assist the operator with setting up the and MINI MAX series of data loggers. The following sections explain the purpose and usage of each program option (Function).

Please refer to Figure 4A below for future data box references.

Figure 4-A

Box Titles

Name	Screen Location
Main Menu Box	Upper Left half of screen
Activity Line	Last line of the Master Menu Box
Memory Status Box	Lower left quarter, under Menu Box
Survey End Box	Lower Left, Inside Memory Stat Box
Real Time Monitor Box	Right side of screen
Input Device Status Box	Upper Right, Inside Real Time Box
Current Setup Box	Lower Right, Inside Real Time Box

Main Menu Box:

This primary Menu is the central focal point for all MINI MAX survey start and survey end data exchanges. You should become familiar with all functional descriptions of each Menu Box item. Notice that a shaded 'selection bar' covers the"communications" Menu item. By pressing the 'Up' or 'Down' arrow keys, we can move the 'selection bar' to any item we may wish to select. Notice that each selection item has one capital letter only. These are the 'HOT' keys. Press the 'C' key. If you are using a color monitor, notice that the image alternates between a black & white and a color screen. We can also select the screen color by positioning the 'selection bar' over the 'screen Color' item (second from top) and then pressing the <CR> key. This procedure is consistent with all Menu selections.

Activity Line: 4-1-2

This line which is located at the bottom of the Main Menu Box (actually inside the Menu border), reflects the current operating mode of the MINI MAX logger. Refer to Figure 4-A and locate this line. Notice the 'Survey On Hold' message. There are several other 'device activity' messages in version 2.0 of this program. They are:

'No Device'	The MINI MAX is NOT connected to the PC.
'Not Configured'	Bad run number, '@@' in Run setup.
'Date Conflict'	The Date and/or time was not properly set.
'Survey On Hold'	The survey has been 'halted' (not recording)
'Recording Data'	Survey is in progress and is storing data.

Memory Status Box: 4-1-3

Please view this box a few times before disconnecting the MINI MAX. This box is updated every 5 seconds and reflects the amount of logger memory used. Please refer to Figure 4-A and locate this data box. The 'Recorded Points' message shows us the actual number of individual data points stored in memory, and the 'Storage Used' message gives us a relative percentage of MINI MAX memory currently used. '100.0%' means the device is FULL and that NO more data points will be recorded.

Survey End Box: 4-1-4

Inside the Memory Status Box, is yet another small box that tells us when the MINI MAX memory will be FULL. The MINI MAX examines the current interval you selected and calculates how long it can 'survive' before overflowing. If you change the current interval, this box will display the correct date and time that you MUST END the survey by. For this feature to operate properly, be sure that the MINI MAX date and time are accurately set.

Real Time Monitor Box: 4-1-5

The entire right half of the display screen is dedicated to this data box. Real time data monitoring allows us to 'see' the transducer activity right now as it is happening.

Two separate secondary boxes are inside this primary box. Each of these data boxes has it's own unique box title (name). For clarity, we will further separate these boxes into left and right columns. The left column being the item category, and the right column being the current value.

Input Device Status Box:

Refer to Figure 4-A and locate this box (top right half). The first current device status row (left) is the MINI MAX current time-of-day (right). The second row reflects the current pressure (left) followed by the actual value (right). The third row indicates the current temperature condition while the fourth row shows the flow rate. Please note that these data rows only indicate the status of connected transducers. The fifth row 'Other' is present for other special purpose transducers. At the bottom of this status box (last row, left), the message 'Purge Valve' followed by either 'OPEN' or 'CLOSED' always indicates the condition of the purge valve.

Current Setup Box: 4-1-6

Refer to Figure 4-A and locate the Current Setup Box. Use this data box for verification of ALL the logger setup parameters. The specific parameter item names are on the left columns and the associated current settings are listed in the right side columns of this data box.

Communication Link 4-2

Note: This program comes pre-set to COM1:9600,N,8,1 as the default communications parameters. The MICRO MAX logger matches this setting. You should not have to bother these settings. Other baud rates can be selected for different Pruett devices. If you accidently select this Function, press the 'ESC' key to return the Main Menu.

Color and Monochrome Screens 4-3

If you are using a LCD (Liquid Crystal Display) monitor, it may necessary to press the 'C' key. This Function toggles the current display color/style mode of operation.

Initial MINI MAX Setup 4-4

Press the 'S' key one time. Notice that the Main Menu disappeared and there is a new data box in its' place. After a second or two, you should see the MINI MAX MENU appear. Please remember to exit this Function, you MUST press the 'TAB' key. At this point, refer to section 3 for setting up the MINI MAX and press the 'TAB' key when you are finished.

Resume Current Survey 4-5

Note: Do NOT select this Function to start a NEW survey. If you have 'halted' the current survey for any reason, and you wish proceed with the logging operation, press the 'R' key.

Start a New Survey 4-6

Before starting a new survey, please check that the required setup is properly configured. Press the 'N' key. Notice that the program responds with a 'ARE YOU SURE' message. This gives us one last chance to change our mind. Any key other than 'Y' will cause this Function to 'abort' and return to the Main Menu.

Saving Survey Data (down load) 4-7

There are two different methods in which the current survey data can be saved to disk. If you intend to resume the current survey after saving current data, press the 'A' key. Notice the small sub menu in the upper right corner of the Menu Box. Press the 'L' (Last data only) key. The program will make a new data box on the left side of our screen. You will actually be able to view the data being retrieved from the MINI MAX. When this operation is completed, a message will appear at the bottom of this data box indicating we have completed the save process. Press the 'ESC' to return to the Main Menu.

Initialize Communications Link to the MINI MAX 4-8

On the main menu of the Mlog software (refer to figure 4-A) you will see established communications. By pressing the letter 'E' or placing the highlight bar over established communications and pressing return, communications with the MINI MAX will be established or reestablished. This should not be necessary because the program continually pulls the data logger. In some instances it may need to be used.

View Previous Files 4-9

This feature allows the operator to view files that he has already saved to disk. (refer to figure 4-A) By pressing the letter 'V' or placing the highlight bar over 'view file' and 'add technical comments' and pressing the return, you will see the screen change and display 'current directory'. At this time you can put in the directory you wish to view or simply press return and the directory that you are currently in will display all .SUR or .SUP or .SUT files. You may move the highlight bar over the file you wish to view and press return twice. A third screen will appear that says 'display file, add operator's comments, start from beginning, cancel file display, or plot current file'. By pressing the 'display file', you can view the contents of that particular file. The page up and page down or arrow keys will allow you to move throughout the survey file. Pressing the escape key will allow you to return to the directory.

Press the return key once again and now move to the add operator's comments line. This will allow you to input comments. These comments are saved in a file called 'OPlog.lst'. In this log, you will see the comments you have typed plus the survey file name as reference. All operator comments will be added to this OPlog file. By pressing return with no comments typed in, you will return to your current directory. Press return again and you will see 'start from beginning'. This simply displays the file from the beginning. Also, you have 'cancel file display'. This will put you back to the directory.

The last choice in this menu is 'plot current file'. Place the highlight bar over this entry and press return. An on screen plot of this entire survey will appear with pressure or temperature on the left and time at the bottom. By pressing the 'L' key and hitting the right

arrow key, you will notice the vertical line on the left of the screen will start to move to the right. By pressing the 'R' key and hitting the left arrow key, you will notice the vertical line on the right move to the left. Place these two lines around the area of the plot which you wish to zoom. Now hit the return once again. You will see on the screen that portion of the survey which lay between the two vertical lines.

At the bottom of the screen you will see <S=scale>, <M=mark points>, <P=print>. By pressing the 's' key, you may put in a new high value and a new low value. This will rascal your plot. Hitting the escape button will return you to your original plot. Press return again and you will see 'M' for mark points. By pressing 'M', you will display the points that actually make up the plot. By pressing 'P' and being plugged into a printer, the survey will be plotted on your printer. Press 'escape' twice and you will return to the main menu of your Mlog software.

Place Current Survey on Hold 4-10

This feature places a running survey on hold (refer to figure 4-A) Use the hold feature prior to 'save data'.

Primary Line Printer Selection 4-11

By placing the highlight bar over 'Printer' or pressing the 'P' key, you can display the possible printer selections. Currently we have MS-1, Epson FX, Epson LQ1500, IBM Pro Printer, Okidata 192,193, Panasonic KX-P. If you own a different printer, simply contact Pruett and we will inform you on how to update your MPRN config file. Place the highlight bar over your particular printer and hit the return. Behind the word 'Printer' you should see your printer displayed.

RS232 Terminal Program 4-12

By pressing the 'T' key or placing the highlight bar over terminal (refer to figure 4-A) and pressing return your computer will go into a terminal mode. It will simply output commands that are typed in on the key pad. Press the tab key to return to the main menu.

DOS Shell Program 4-13

By typing in 'O' or placing the highlight bar over DOS Shell, (refer to figure 4-A) and pressing return, you will be placed at the DOS prompt. Do not forget you are still in the program. You may use the DIR command or any other DOS commands while inside this DOS shell. To return to the main menu, type EXIT and hit return.

File Format 4-14

By typing in 'F' or placing the highlight bar over File Format (refer to figure 4-A) and pressing return, you will see another window. In this window are three types of formats which the Mlog Software will save: The Pruett standard, which is the format used with Pruett Industries Print and Plot Software, The IEEE FP compressed, which is a compressed format used mainly for modem or telmetry, or the Lotus Export, which displays the file in Lotus real time format. This format is convenient for viewing in that the data points are related to real time. When the Lotus Export format is used, a .SUR or raw data file is also saved so that the Pruett format could be generated. By placing the highlight over one of the three choices and hitting return, the format type you wish to use will appear behind the words File Format in the main directory.

Quit Exit to DOS 4-15

By hitting the letter 'Q' or placing the highlight bar on Quit (refer to figure 4-a) the Mlog program will be terminated. Remember to view the screen in the MINI MAX to make sure that the survey is either recording data or on hold, however you wish it to be, before terminating the Mlog Program.

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CHAMBER CHECK

The purpose of a chamber check is to insure that capillary tubing is free of fluid and correct bottom-hole pressures are being observed. Theory behind chamber checking is such that when a small amount of gas is released from the system at surface, the stabilized pressure downhole should not change more than 1 psi, provided fluid interface is located in the pressure chamber. If fluid interface is in the capillary tubing, the small amount of gas released at the surface will indicate a decrease in pressure greater than 1 psi.

Examples: (1) If a 10 ft. capillary tubing whip is filled with purge gas while chamber checking in a water environment, the pressure will decrease approximately 4.4 psi if fluid is in the capillary tubing [Fluid Gradient (.44) multiplied by Length of Capillary Tubing (10 ft.) = 4.4 psi].

(2) If a 100 ft. capillary tubing whip is filled with purge gas while chamber checking in a water environment, the pressure will decrease approximately 44 psi if fluid is in the capillary tubing [Fluid Gradient (.44) multiplied by Length of Capillary Tubing (100 ft.) = 44 psi].

PROCEDURE:

1) Record pressure when the well is fairly stable.

2) At the fitting(s) marked "Purge Fitting" in figure 1, loosen capillary tubing connection allowing purge gas to escape for approximately two (2) seconds. Re-tighten capillary tubing connection and check for gas leakage with a leak detector fluid (i.e., Snoop).

3) Watch the pressure stabilize on the monitor. Pressures should come back to within 1 psi of the original stabilized pressure. This would indicate the wellbore medium and compressed gas interface are located in the pressure chamber and that no fluid has entered the capillary tubing. System checks good.

4) Should the pressure come back 4 psi lower than the original pressure, that would indicate fluid has entered the capillary tubing.

5) When a chamber check indicates fluid has entered the capillary tubing, the fluid must be purged out before proceeding.

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6) To purge out the fluid, pressure in the gas bottle must exceed downhole pressure by 1000 psi or greater. If a bottle pressure is not enough to meet this specification a High Pressure Purge Booster is required.

7) Whether a Booster is or a gas bottle are used if the pressure is greater than the transducer maximum pressure rating, the transducer must be disconnected or shut off at the two stem, three-way valve before purging.

8) Purge capillary tubing for ten minutes. Watch pressure stabilize and record stabilized pressure after purging. Purge once again.

9) Pressures must return after the second purge to that of the first purge. If not, fluid is still in the capillary tubing. Repeat this procedure until pressure comes back the same as the prior observed pressure.

10) Chamber check again.

11) Re-purge after chamber checking.

NOTE: Always re-purge after chamber checking. This will place the interface at the bottom of a chamber, giving the tool it's greatest capacity during pressure build up situations.

12) When pressure comes back the same after chamber checking and purging, capillary tubing is free of fluid.

13) Whenever fluid is found in the capillary tubing, re-purging 24 hours after all fluid was removed is advisable because of fluid condensation at the bottom of the capillary tubing.

APPENDIX IV

Seismometer Installation Schedule

University of Hawaii at Manoa

Hawaii Natural Energy Institute
Holmes Hall 246 • 2540 Dole Street • Honolulu, Hawaii 96822

MEMO

13 July 1994

To: Dean A. Nakano

From: Harry J Olson

Subject: Seismometer Installation Schedule

cc: P. Cooper, SOEST
E. Granados, GeothermEx
R. Hodges, USGS
R. Kochy, NELHA
J. Moulds, Co. of Hawaii
E. Pruett, Pruett International
P. Takahashi, HNEI
D. Thomas, HIG
E. Yamamoto, DOH
H. Young, DLNR
L. Young, DOH
Supervisor, Well Maintenance Crew
Crane Operator

Installation of the seismometer into the HGP-A well is now scheduled for Monday through Thursday, July 18 through 21. This schedule is an estimate of the time required and may change due to unanticipated delays or operational difficulties. Harry Olson, HNEI, will manage the installation operation, and Eduardo Granados, GeothermEx, will be in charge of all installation operations. The attached installation plan will be followed, and any deviation from the plan must be approved by GeothermEx. Don Thomas will be coordinate temperature logging of the HGP-A well using the USGS logging truck. The installation schedule is as follows:

Day 1, Monday, 18 July

A.M.
- o Mobilize Crane and manlift to PRC. Assemble all involved personnel for on-site inspection and briefing and check out all equipment and supplies. Make last minute planning and schedule changes.
- o Rig-up crane and manlift at HGP-A well.

P.M.
- o Remove Pruett downhole pressure monitor and capillary tubing.
- o Run Kuster temperature/pressure survey in HGP-A. Take T/P measurement every 100 feet at 5 minute intervals to a depth of 2,000 feet.
- o Close HGP-A master valve.

Day 2, Tuesday, 19 July

A.M.
- o Remove T/P lubricator, install lubricator for USGS temperature survey and downhole temperature tool in lubricator.
- o Open master valve.
- o Run USGS temperature survey in HGP-A to a maximum depth of 2,000 feet.

Note - USGS temperature survey will be completed and the tool out of the hole in a maximum time of 4 hours or less.

Day 3, Wednesday, 20 July

- o Spool seismometer cable on USGS logging truck reel or other appropriate spool.
- o Install downhole seismometer in HGP-A well at a depth (about 850 feet) to be determined by Pat Cooper .

Day 4, Thursday, 21 July

- o Check seismometer for proper installation and operation. Pat Cooper is to determine when the seismometer is installed and functioning properly.
- o Release crane and manlift, equipment, and personnel.
- o Clean up site.

CHARGES:

The M&T project will incur all charges for the installation of the downhole seismometer.

The HIG project will incur all charges during the time that the USGS logging truck is involved with the temperature survey. Charges will include, but not be limited to, crane and manlift hourly charges, and standby charges for GeothermEx and Pruett International.

w/attachment

m&t2/mw/INSTALL

PLAN FOR THE INSTALLATION OF THE SEISMOMETER IN WELL HGP-A PUNA - HAWAII

Day 1:

- Call crane services to alert operators to be at the site at 7:~~20~~ 30 am (Olson)

- Mobilize PGV's wireline hoist to the site and alert PGV's well maintenance crews to inspect wellnead flange and all wellhead valves at the site in order to bring later the necessary tools to nipple off the flange. (Olson)

- At 7:30 am, meet at the HGP-A wellsite and hold safety meeting. All parties involved must attend (Granados). Time: 30 minutes

- Inspect PGV's and HNEI's hoists. Determine if capillary tubing can be pulled out without cutting. If not possible, cut tubing and start spooling (approximately 2,000 feet) in the drum of the selected hoist (Granados - Pruett). Time 1 hour

- Rig up crane and manlift at the wellsite (Olson - Granados) Time: 30 minutes

- Pull out the chamber into the lubricator, close master valve and dismantle the top portion of the 2-inch lubricator (Granados - Pruett - PGV's crews) Time: 3 hours

- Transfer the capillary tubing to a spare spool (Pruett - Granados) Time:

1-1/2 hours

- Prepare tandem of temperature/pressure Kuster tools. Set tools inside 2-inch lubricator. Set lubricator back on the well. Open master valve. Run survey to 2,000 feet with stops every 100 feet (Granados - Pruett, PGV's crews) Time: 3 hours

- Pull survey tools out of the well, close master valve. Set lubricator on side. Inspect survey charts (Granados - Pruett, PGV's crews) Time: 1-1/2 hours

Day 2:

- At 7:30 am, rig up PGV's crews to tear off 10" X 4" spool from the wellhead (it may be necessary to dissassemble the wellhead centralizing structure to do this operation, in which case add 2 hours to this operation). Clean and inspect DSA flange gasket groove and ring gasket. Set new 10" X 6" spool (Granados - Pruett - PGV's crews) Time: 3-1/2 hours

- Nipple up bottom portion of 6-inch lubricator (Granados - Pruett - PGV's crews) Time: 1-1/2 hours

- Set USGS temperature tool inside top portion of 6-inch lubricator. Lift and nipple up lubricator. Open master valve slowly and pressurize new lubricator. Inspect for leaks on connections. Complete opening of master valve (Granados - Pruett - PGV's crews) Time: 1 hour

- Run USGS temperature survey. Observe weight indicator on the USGS unit. If line looses weight, end survey at this point. Do not attempt to work tool inside obstructions (Granados - Olson - USGS) Time: 3 hours

- Pull tool out of the well into lubricator. Close master valve. Dissassemble lubricator and set down on ground. Pull USGS temperature tool (Granados - USGS) Time: 1 hour

Day 3:

- At 7:30 am, unpack seismometer instrument and 7/16" cable spool and mount on appropriate frame. If not possible to use USGS connector to monitor instrument from the logging unit, use cable clamps to attach 7/16" cable to electric wire on USGS truck, directly above USGS's cablehead. Spool five or six turns of cable into USGS hoist before applying any tension to cable. (Granados - Cooper - USGS - Pruett) Time: 1 hour

- Secure 7/16" cable to frame and start transferring into USGS hoist drum. Measure length of cable being transferred through USGS's measuring reel (Granados - Cooper - USGS - Pruett) Time: 2 hours

- Once all cable has been spooled into the USGS unit, pass the 7/16" line through the large lubricator's stuffing box. Attach seismometer to the cable connector. At this point if it was possible to operate the seismometer from the logging truck, proceed with the installation checkup procedure. If cable splicing with clamps was necessary, continue to next step (Granados - Cooper - USGS - Pruett) Time: 3 hours

- Install wellhead sheave. Set seismometer inside lubricator and raise lubricator using the crane. (Granados - Pruett - USGS) Time: 1 hour

- Attach and secure the lubricator to the wellhead. Open the master valve (Granados - Pruett - USGS - PGV's crews) Time: 30 minutes

- Start lowering the instrument into the hole to the desired depth. Special care must be taken to leave at least four to five turns of cable in the drum when reaching the desired depth (Granados - Cooper - USGS) Time: 2-1/2 hours

- Secure the wire clamp to the top of the lubricator. Raise the instrument slightly to ensure it is free. Unload rest of cable from USGS hoist. Attach connectors and continue with the instrument check procedure. Activate clamping arm. Pull instrument very slightly to ensure it is fixed in place to the well casing. (Granados - Cooper - USGS - Pruett) Time: 2 hours

Day 4:

- At 8:00: Test instrument for signal quality. Mount instrument controls inside PRC building. Tighten and secure stuffing box nut in the lubricator to prevent accidental venting of gases. (Cooper - Granados) Time: 3 hours

- Double-check wire clamp and lubricator flange connections. Use H_2S detectors and "Snoop Liquid Leak Detector" around all new connections to check for possible leaks (Granados) Time: 1 hour

- Demobilize USGS and PGV units. Demobilize cranes and clean out the site (Granados - Olson - USGS - Cooper) Time: 2 hours